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THEORETICAL CALCULATIONS OF THE PHENOMENOLOGY OF DISTANT PLAIN EVENT 6

Edmund A. Nawrocki, Captain, USAF
William A. Whitaker, Major, USAF
Charles E. Needham

TECHNICAL REPORT NO. AFWL-TR-67-57

July 1967

AIR FORCE WEAPONS LABORATORY
Research and Technology Division
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FOREWORD

This research was performed under Program Element 7.60.08.01.D, Project 5710, Subtask 1.027, and was funded by the Defense Atomic Support Agency (DASA).

Inclusive dates of research were 1 March 1967 to 1 April 1967. The report was submitted 1 June 1967 by the Project Officer, Captain Edmund A. Nawrocki, (WLRT).

This report has been reviewed and is approved.

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ABSTRACT

Theoretical calculations of the phenomenology of an atmospheric high-explosive detonation are presented. The charge was a 100-ton sphere (radius, 240.5 cm) of TNT (loading density, 1.56 gms/cm^3) whose center was at an altitude of 646.405 meters. The ground, upon which the spherical charge rested, was 644 meters above sea level. The numerical calculations taken out to 6 seconds were performed on the CDC 6600 digital computer using SHELL2, a two-material (version of the SHELL-OIL code), two-dimensional pure Eulerian hydrodynamic code. Air and the detonation products of TNT were the two materials considered in the calculation. The analytic, self-similar solution for the detonation wave in TNT provided the initial conditions. Included are pressure and density contours, velocity vector plots, and wave forms for 19 test stations. This calculation is a representation of the air blast of Event 6 of the DISTANT PLAIN test series to be fired in Canada, July 1967.

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INTRODUCTION

The United States is participating with the United Kingdom and Canada in a non-nuclear test series taking place in Alberta, Canada. The purpose of this series, called Operation DISTANT PLAIN, is to obtain experimental data, using high explosives and detonable gases, which may be applied toward solution of problems concerning nuclear blast effects on military targets.

At the request of the Defense Atomic Support Agency (DASA), the Air Force Weapons Laboratory (AFWL) performed several one- and two-dimensional theoretical pre-shot calculations of events held in the summer of 1966 (Ref. 1). These calculations were performed on the CDC 6600 electronic digital computer using SAP, a one-dimensional hydrodynamic code and SHELL, a two-dimensional, pure Eulerian hydrodynamic code. Included in these numerical experiments was the calculation of such physical phenomena as the detonation process, that is, the "burn" of the explosive substance, shock formation and growth, shock reflection, mach stem formation, and triple point path as well as blast parameters such as peak overpressures, dynamic pressures, positive phase durations, positive impulses, and shock arrival times of the air blast wave. Agreement between theoretical results as computed by the hydrodynamic computer codes and the experimental data is excellent (Ref. 2).

DASA has again requested the AFWL to perform theoretical calculations of DISTANT PLAIN Event 6 scheduled for July 1967. This event involves the detonation of a spherical charge of 100 tons of TNT resting on the ground. Reported in this document are the results of these calculations.

SECTION II

THE CALCULATION

We performed the numerical calculation reported here on the CDC-6600 electronic digital computer. The computer time required to carry the calculation out to 6 seconds was approximately 50 hours. SHELL2 was the code used to make this calculation.

1. SHELL2

SHELL2 is the two-material version of SHELL-OIL, a two dimensional, axially symmetric, pure Eulerian hydrodynamic code. Since SHELL-OIL is described in considerable detail in reference 1 we shall only present a brief description of its computing method here. However, we shall give a more detailed description of the treatment of two materials.

a. SHELL-OIL

SHELL-OIL solves problems in compressible fluid dynamics by dividing the region occupied by the fluid into a mesh of fixed cells and then forming finite difference analogs to the Eulerian hydrodynamic equations. The fluid is described at any instant of time by specifying the velocity, density, and specific internal energy of the fluid contained in each cell. These values are considered known at the center of each cell and constant over it.

SHELL-OIL is a time-marching code. Using the finite difference analogs, it numerically integrates the hydrodynamic equations, updating the values of the thermodynamic variables describing the fluid in each cell of the computational mesh to time, $t + \Delta t$ based upon their respective values at time, t. During each time cycle of calculation it performs the following operations.

(1) It calculates a time step, Δt, such that

$$t = 1/2 \left|\frac{\Delta x}{v}\right|$$

where the quotient $(\Delta x/v)$ is the minimum of the entire mesh. The velocity, v, may be either a particle velocity or the sound speed of a cell and Δx its minimum dimension.

(2) An equation of state, $p = p(\rho, I)$, assigns a pressure to each cell where

$\rho \equiv$ the density of the cell in gms/cm^3

$I \equiv$ the specific internal energy of the cell in ergs/gm.

(3) Phase 1. Solution of the equations for the conservation of momentum and energy, neglecting fluid motion (i.e., the convective terms, $\vec{v} \cdot \nabla \vec{v}$ and $\vec{v} \cdot \nabla I$, respectively, are dropped) gives tentative new values for velocity and specific internal energy respectively. That is, Phase 1 calculates only the pressure contribution to $\Delta\vec{v}$ and ΔI. The ΔI calculation uses a time-centered velocity, 1/2 (old v + tentative new v) (Ref. 3).

(4) Phase 2. Solution of the equation for conservation of mass gives the mass flow across each cell boundary. Donor cell densities and velocities, interpolated between the donor and receiver cell, determine the amount of mass flow. The velocities used are the tentative new velocities calculated in Phase I.

(5) Repartitioning. Conservation of mass, momentum, and total energy determines the final values for mass, velocity and specific internal energy of each cell. Whenever some mass leaves one cell for another, it carries with it momentum (Δmu - radial momentum, Δmv - axial momentum), kinetic energy $\left[1/2\ \Delta m\left(u^2 + v^2\right)\right]$ and internal energy (ΔmI) where Δm is the amount of mass transferred and u, v, and I are the radial velocity, axial velocity, and specific internal energy of the donor cell. These values are subtracted from the donor cell and added to the receiver cell. Conserving mass gives the final value of mass for each cell. Conserving momentum gives the final values of velocity. Conserving total energy gives the final value of specific internal energy.

b. Two-Material Considerations

The first requirement necessary for taking a second material into consideration in the hydrodynamic calculations is additional computer storage. Storage is required for a second mass block and a second internal energy block; that is, the amount of mass and internal energy of the second material present in each cell must be known. The operations of SHELL2 proceed as follows.

(1) The calculation of a time step in the two-material version of the code is exactly the same as for the one-material version outlined above.

(2) The appropriate equation of state assigns a pressure to each cell containing only one kind of material. For those cells which contain a mixture

of both materials, the requirement of pressure continuity across a material interface determines the pressure of these cells. That is

$$p = p_1\left(\rho'_1, I_1\right) = p_2\left(\rho'_2, I_2\right)$$

where I_1 and I_2 are the specific internal energies of the first and second material, respectively, in a mixed cell. The densities ρ'_1 and ρ'_2 are the "effective" densities of each material:

$$\rho'_1 = \frac{M_1}{V'_1}$$

$$\rho'_2 = \frac{M_1}{V'_1}$$

$$V = V'_1 + V'_2$$

where M_1 and M_2 are the masses of each material contained in a mixed cell whose volume is V. Since all quantities are known except the "effective" volumes of each material, the pressure of a mixed cell must be determined by iteration.

(3) Phase 1 of the two-material calculation proceeds exactly in the same manner as in the one-material case outlined above. The only exception is that for cells containing a mixture of both materials, the change in specific internal energy, ΔI, must be distributed between the two materials. Assuming that changes in a mixed cell take place adiabatically, the change in internal energy of each material, ΔI_1 and ΔI_2, respectively, is

$$\Delta I_1 = \frac{\frac{\gamma_1 - 1}{\gamma_1} M_1 I_1}{\frac{\gamma_1 - 1}{\gamma_1} M_1 I_1 + \frac{\gamma_2 - 1}{\gamma_2} M_2 I_2} \Delta I$$

$$\Delta I_2 = \frac{\frac{\gamma_2 - 1}{\gamma_2} M_2 I_2}{\frac{\gamma_1 - 1}{\gamma_1} M_1 I_1 + \frac{\gamma_2 - 1}{\gamma_2} M_2 I_2} \Delta I$$

(Ref. 3) where the γ's are the ratios of specific heats of each material.

(4) Phase 2 also proceeds in exactly the same manner as in the one-material case. Here again the exception is that the mass transported from a mixed cell must be divided between the two materials. The apportionment is proportional to the amount of mass of each material present in the donor cell.

$$\Delta M_1 = \frac{M_1}{M_1 + M_2} \Delta M$$

$$\Delta M_2 = \frac{M_2}{M_1 + M_2} \Delta M$$

In effect this procedure calculates the transfer of each material independently.

Since Eulerian cells are homogeneous, which leads to a false material diffusion, special care must be taken not to allow one material to erroneously diffuse through the other. To counteract this possibility, before a given material is allowed to transfer to a cell which does not have any material of this type, its presence in the donor cell must be in sufficient quantity such that it is at least a predetermined minimum percentage of the total mass of the donor cell.

(5) Repartitioning is also similar to that in the one-material version. For cells containing one material it is exactly the same. For mixed cells conservation of momentum is also the same:

$$u^{(n+1)} = \frac{R^{(n+1)}}{M_1^{(n+1)} + M_2^{(n+1)}}$$

$$v^{(n+1)} = \frac{Z^{(n+1)}}{M_1^{(n+1)} + M_2^{(n+1)}}$$

where $R^{(n+1)}$ is the post-transport radial momentum in a mixed cell and $Z^{(n+1)}$ is the post-transport axial momentum in a mixed cell. The updated values of specific internal energy for each material in a mixed zone come from the independent conservation of total energy for each material.

$$I_1^{(n+1)} = \frac{TE_1^{(n+1)}}{M_1^{(n+1)}} - 1/2\left[\left(u^{n+1}\right)^2 + \left(v^{n+1}\right)^2\right]$$

$$I_2^{(n+1)} = \frac{TE_2^{(n+1)}}{M_2^{(n+1)}} - 1/2\left[\left(u^{n+1}\right)^2 + \left(v^{n+1}\right)^2\right]$$

where the TEs are the post-transport total energies of each material in a mixed zone.

2. Initial Conditions

The SHELL2 computational mesh contained 123 cells in the z-direction and 121 cells in the radial direction for a total of 14,883 cells. All cells except the bottom row of 121 cells comprised the active mesh. Each cell in the bottom row was 644 meters high (Δz) and 5 cm wide (Δr). Each cell in the active mesh was a 5-cm square. Therefore, the overall mesh extended from sea level to an altitude of 650.1 meters and out to a radius of 6.05 meters; and the active portion of the mesh, from 644 meters (ground level) to an altitude of 650.1 meters. The bottom boundary (ground level at 644 meters) was reflective; the top and right boundaries were transmittive and thus subject to rezone (Ref. 1) in their respective directions. The left boundary (r=0) was the axis of symmetry.

All cells in the active mesh with the exception of those contained in a sphere whose center was on the z-axis at an altitude of 646.405 meters and whose radius was 240.5 cm contained an ambient (real) atmosphere (Ref. 1). A similarity solution of the flow field behind the detonation front provided values of velocity, density, and specific internal energy which were fitted into those cells contained in the sphere (see figure 1). Table I contains the data of the detonation wave.

A Lagrangian interface of 715 trace particles simulated the motion of the TNT-air interface. These particles were initially placed in a semicircle whose center was on the z-axis at altitude of 646.405 meters and whose radius was 240.5 cm. There were also 701 more trace particles placed in those cells containing the detonation products of TNT. These particles did not affect the hydrodynamic calculation in any way. Their motion, calculated with interpolated cell velocities, depending on their position in a cell, merely indicated the material interface and gave a general picture of the motion of the TNT detonation products.

Also introduced into the calculation were 19 "test stations" where the overpressures, dynamic pressures, impulses, and velocities were calculated each cycle. The positions of these test stations were chosen to coincide with the position of the experimental stations. See table II and figure 2.

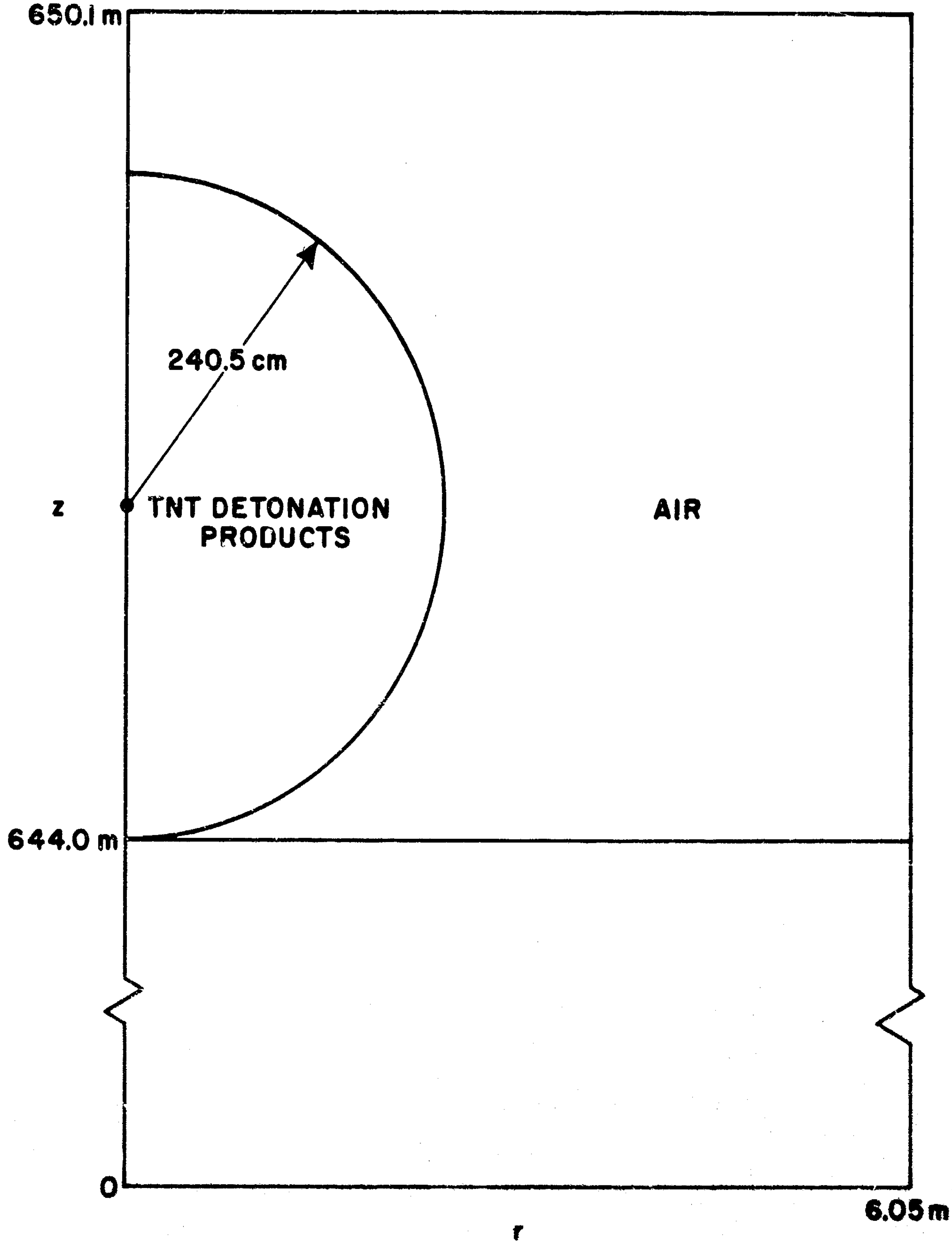

Figure 1. Initial Configuration of SHELL2 Mesh.

The two materials considered in this calculation were the TNT detonation products and air. The corresponding equations of state used in the calculation were the LSZK equation of state for the former and the Doan-Nickel equation of state for the latter.

Table I

DETONATION WAVE FOR TNT (ρ_o = 1.56 gms/cc)

R (cm)	Specific Internal Energy (ergs/gm)	Density (gms/cc)	Velocity (cm/sec)
0.	2.70363E+10	1.23740E+00	0.
1.09026E+02	2.70363E+10	1.23740E+00	0.
1.09788E+02	2.70410E+10	1.23756E+00	3.96930E+01
1.15627E+02	2.73099E+10	1.24674E+00	2.28904E+03
1.22050E+02	2.77351E+10	1.26116E+00	5.69713E+03
1.27617E+02	2.81772E+10	1.27604E+00	9.10522E+03
1.32733E+02	2.86339E+10	1.29128E+00	1.25133E+04
1.37551E+02	2.91039E+10	1.30685E+00	1.59214E+04
1.42146E+02	2.95862E+10	1.32269E+00	1.93295E+04
1.46564E+02	3.00802E+10	1.33879E+00	2.27376E+04
1.50832E+02	3.05851E+10	1.35510E+00	2.61457E+04
1.54968E+02	3.11005E+10	1.37162E+00	2.95538E+04
1.58986E+02	3.16260E+10	1.38833E+00	3.296[illegible]E+04
1.62894E+02	3.21611E+10	1.40520E+00	3.637[illegible]E+04
1.66698E+02	3.27055E+10	1.42222E+00	3.97781E+04
1.70402E+02	3.32587E+10	1.43937E+00	4.318[illegible]E+04
1.74006E+02	3.38204E+10	1.45665E+00	4.65943E+04
1.77519E+02	3.43903E+10	1.47403E+00	[illegible]
1.80935E+02	3.49680E+10	1.49151E+00	5.34104E+04
1.84256E+02	3.55532E+10	1.50907E+00	5.681[illegible]E+04
1.87484E+02	3.61455E+10	1.52670E+00	6.02766E+04

Table I (cont'd)

R (cm)	Specific Internal Energy (ergs/gm)	Density (gms/cc)	Velocity (cm/sec)
1.90616E+02	3.67445E+10	1.54439E+00	6.36347E+04
1.93653E+02	3.73501E+10	1.56213E+00	6.70428E+04
1.96594E+02	3.79617E+10	1.57991E+00	7.04509E+04
1.99439E+02	3.85792E+10	1.59771E+00	7.38590E+04
2.02186E+02	3.92020E+10	1.61553E+00	7.72671E+04
2.04835E+02	3.98299E+10	1.63336E+00	8.06752E+04
2.07385E+02	4.04626E+10	1.65118E+00	8.40833E+04
2.09837E+02	4.10996E+10	1.66900E+00	8.74914E+04
2.12188E+02	4.17407E+10	1.68679E+00	9.08995E+04
2.14439E+02	4.23854E+10	1.70454E+00	9.43076E+04
2.16590E+02	4.30334E+10	1.72226E+00	9.77157E+04
2.18641E+02	4.36844E+10	1.73994E+00	1.01124E+05
2.20592E+02	4.43380E+10	1.75755E+00	1.04532E+05
2.22443E+02	4.49939E+10	1.77510E+00	1.07940E+05
2.24195E+02	4.56517E+10	1.79258E+00	1.11348E+05
2.25848E+02	4.63110E+10	1.80998E+00	1.14756E+05
2.27403E+02	4.69716E+10	1.82729E+00	1.18164E+05
2.28862E+02	4.76330E+10	1.84451E+00	1.21572E+05
2.30225E+02	4.82950E+10	1.86163E+00	1.24980E+05
2.31493E+02	4.89571E+10	1.87865E+00	1.28389E+05
2.32669E+02	4.96192E+10	1.89555E+00	1.31797E+05
2.33754E+02	5.02808E+10	1.91233E+00	1.35205E+05

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Table I (cont'd)

R (cm)	Specific Internal Energy (ergs/gm)	Density (gms/cc)	Velocity (cm/sec)
2.34749E+02	5.09416E+10	1.92898E+00	1.38613E+05
2.35656E+02	5.16014E+10	1.94551E+00	1.42021E+05
2.36478E+02	5.22598E+10	1.96191E+00	1.45429E+05
2.37216E+02	5.29165E+10	1.97816E+00	1.48837E+05
2.37872E+02	5.35713E+10	1.99427E+00	1.52245E+05
2.38450E+02	5.42238E+10	2.01023E+00	1.55653E+05
2.38950E+02	5.48738E+10	2.02604E+00	1.59061E+05
2.39376E+02	5.55211E+10	2.04170E+00	1.62469E+05
2.39729E+02	5.61653E+10	2.05720E+00	1.65878E+05
2.40013E+02	5.68063E+10	2.07253E+00	1.69286E+05
2.40230E+02	5.74438E+10	2.08770E+00	1.72694E+05
2.40381E+02	5.80775E+10	2.10270E+00	1.76102E+05
2.40471E+02	5.87072E+10	2.11753E+00	1.79510E+05
2.40500E+02	5.93328E+10	2.13219E+00	1.82918E+05

Table II

STATION POSITIONS

Station number	Range (ft)	Altitude (ft)
1	25	0
2	35	0
3	48	0
4	57	0
5	69.3	0
6	85	0
7	115	0
8	170	0
9	232.4	0
10	270	0
11	340	0
12	400	0
13	550	0
14	850	0
15	0	25
16	0	35
17	12	0
18	15	0
19	21	0

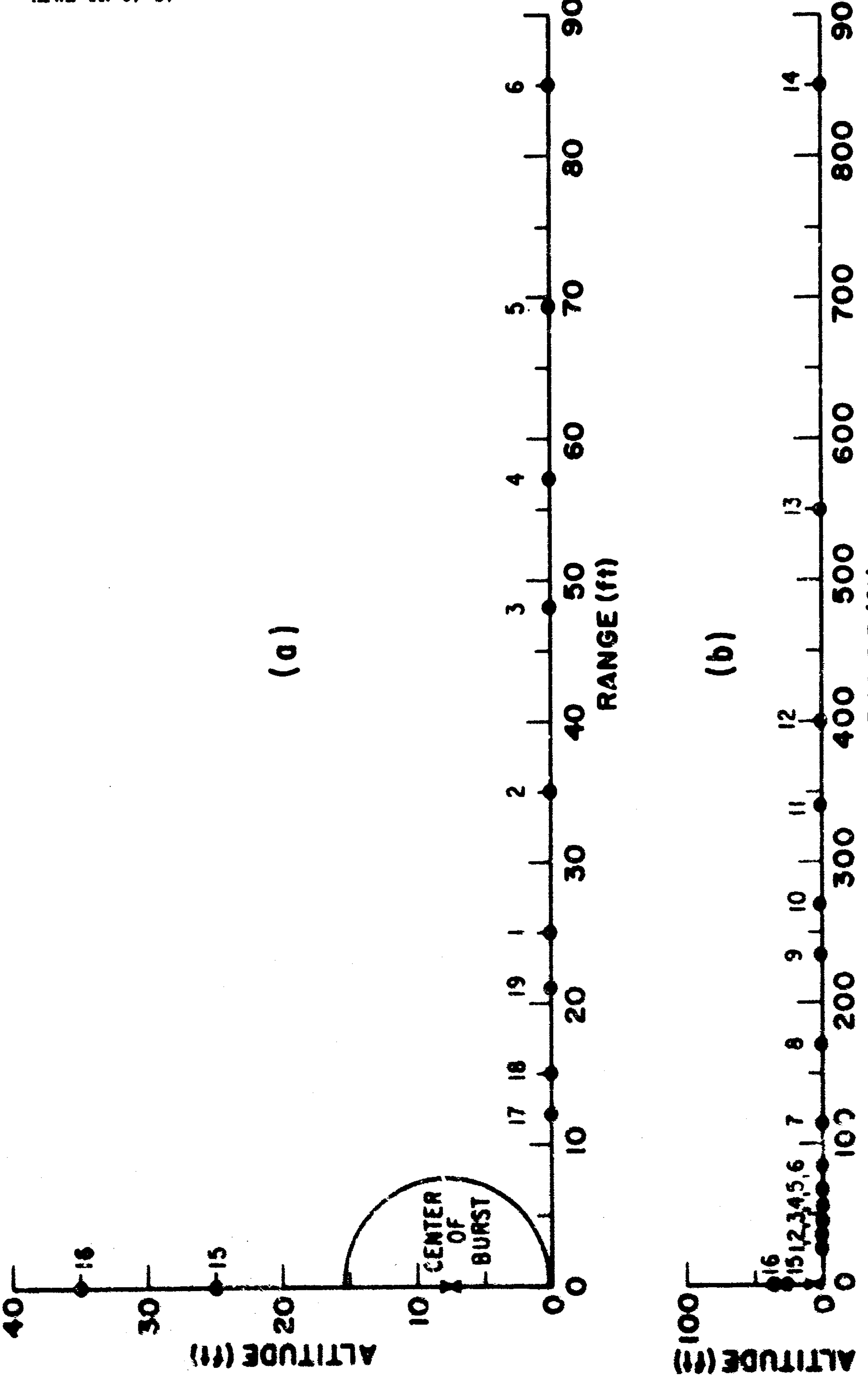


Figure 2. Position of Test Stations.

SECTION III

RESULTS

The SHELL2 calculation began with an analytic (Taylor) solution for the detonation as the starting conditions. The detonation wave, which reached the surface of the TNT (ρ_o = 1.56 grams/cm^3) sphere at 0.35285 millisecond following initiation of detonation, had the following parameters:

Detonation wave velocity	6.816×10^5 cm/sec
Pressure	1.945×10^{11} dynes/cm
Density	2.132 gms/cm^3
Particle velocity	1.829×10^5 cm/sec
Specific internal energy	5.933×10^{10} ergs/gm

Figures 3 through 9 give a summary of blast parameters obtained from this calculation. The appendixes contain plots giving a detailed history of the calculation.

1. Free-Field Phenomenology

The calculation began with the free expansion of the detonation products into air. The ground, which SHELL2 treated as a perfectly reflecting plane, destroyed the symmetry of the problem at the very beginning. The effects of the ground were first evident at the point of the tangency where the TNT sphere was resting on the ground. As the calculation progressed, the ground effects spread very quickly over the entire region of interest.

The phenomenology in the vertical direction from the point of burst resembled that of free air longer than in any other direction. When the detonation wave reached the surface of the TNT sphere, the pressure profile had a peak of 1.945×10^{11} dynes/cm^2 at the surface (r=240.5 cm) and decreased to 4.47×10^{10} dynes/cm^2 at r = 110 cm. This pressure remained constant back to r = 0. At this time the detonation products escaped into the air with maximum escape velocities of 5×10^5 cm/sec. This rapid expansion of the detonation products accelerated the air just in front of it, thus producing a shock wave. Meanwhile a second wave, a rarefaction wave, propagated into the detonation products, decreasing the pressure as it proceeded inward. See figure 3. The rarefaction wave reached the center at about 0.95 millisecond. A second shock wave formed

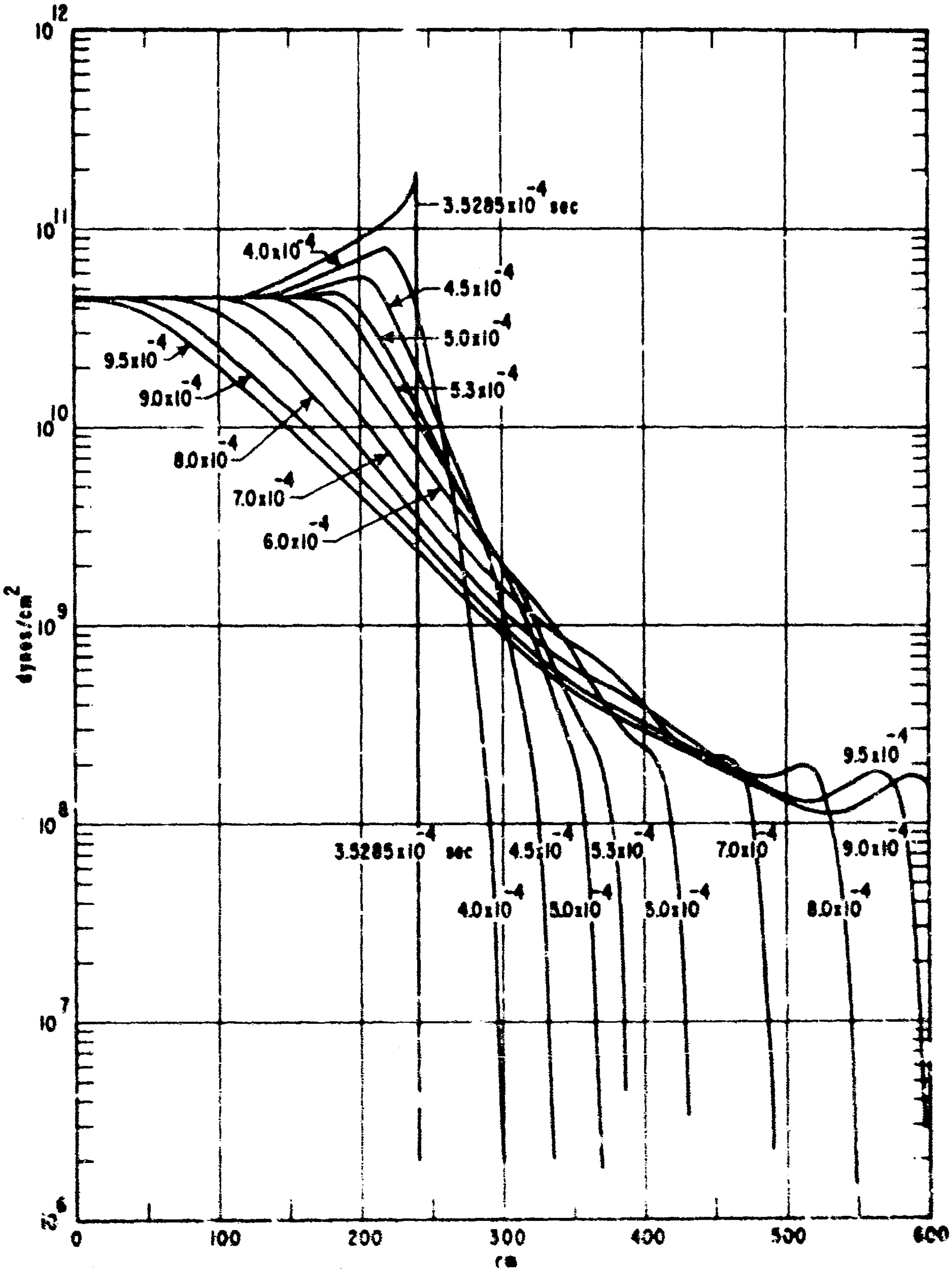


Figure 3. Free Expansion of the Detonation Products Vertically Upward from Center of Burst.

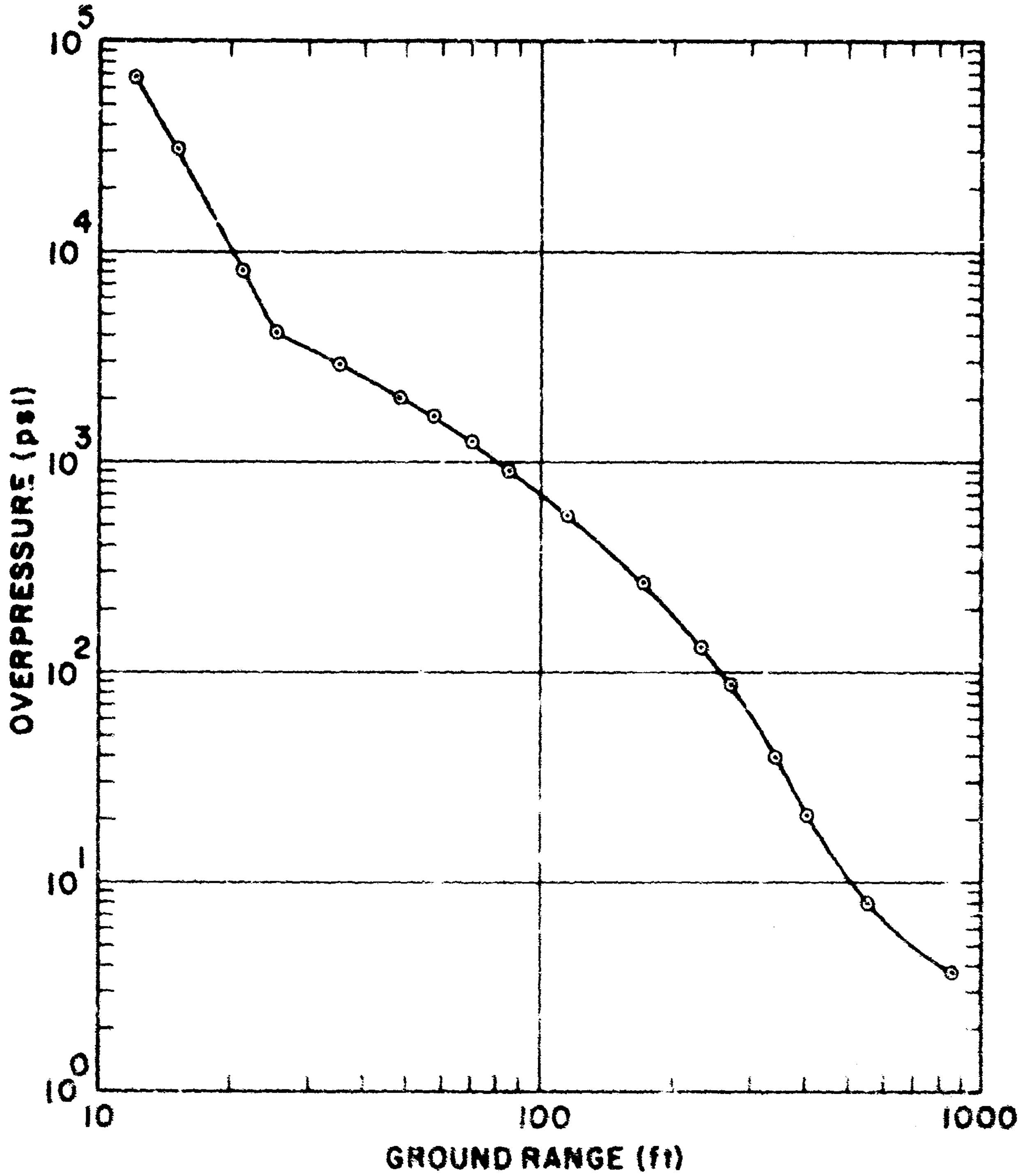


Figure 4. Overpressure vs. Ground Range.

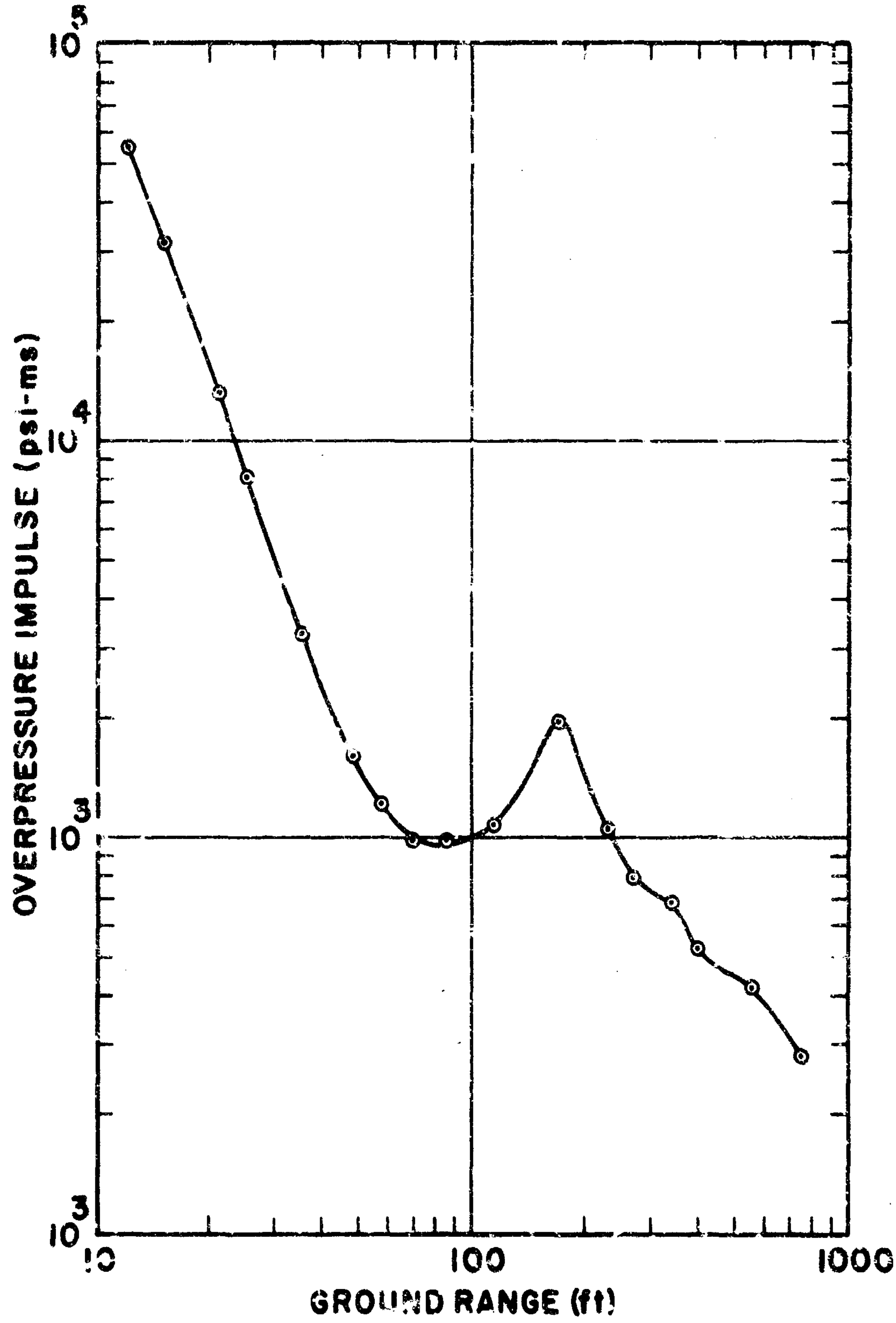


Figure 5. Overpressure Impulse vs. Ground Range.

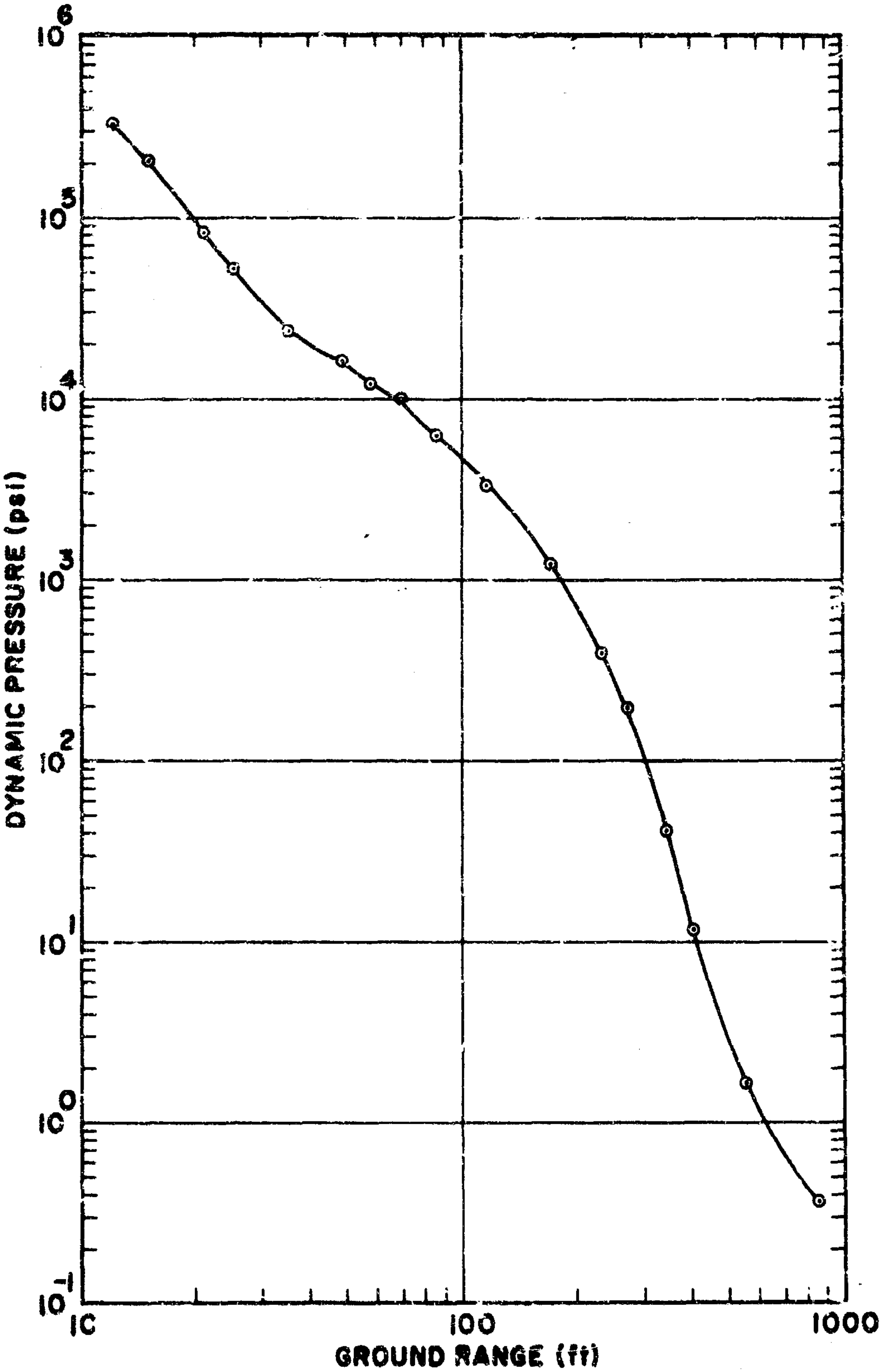


Figure 6. Dynamic Pressure vs. Ground Range.

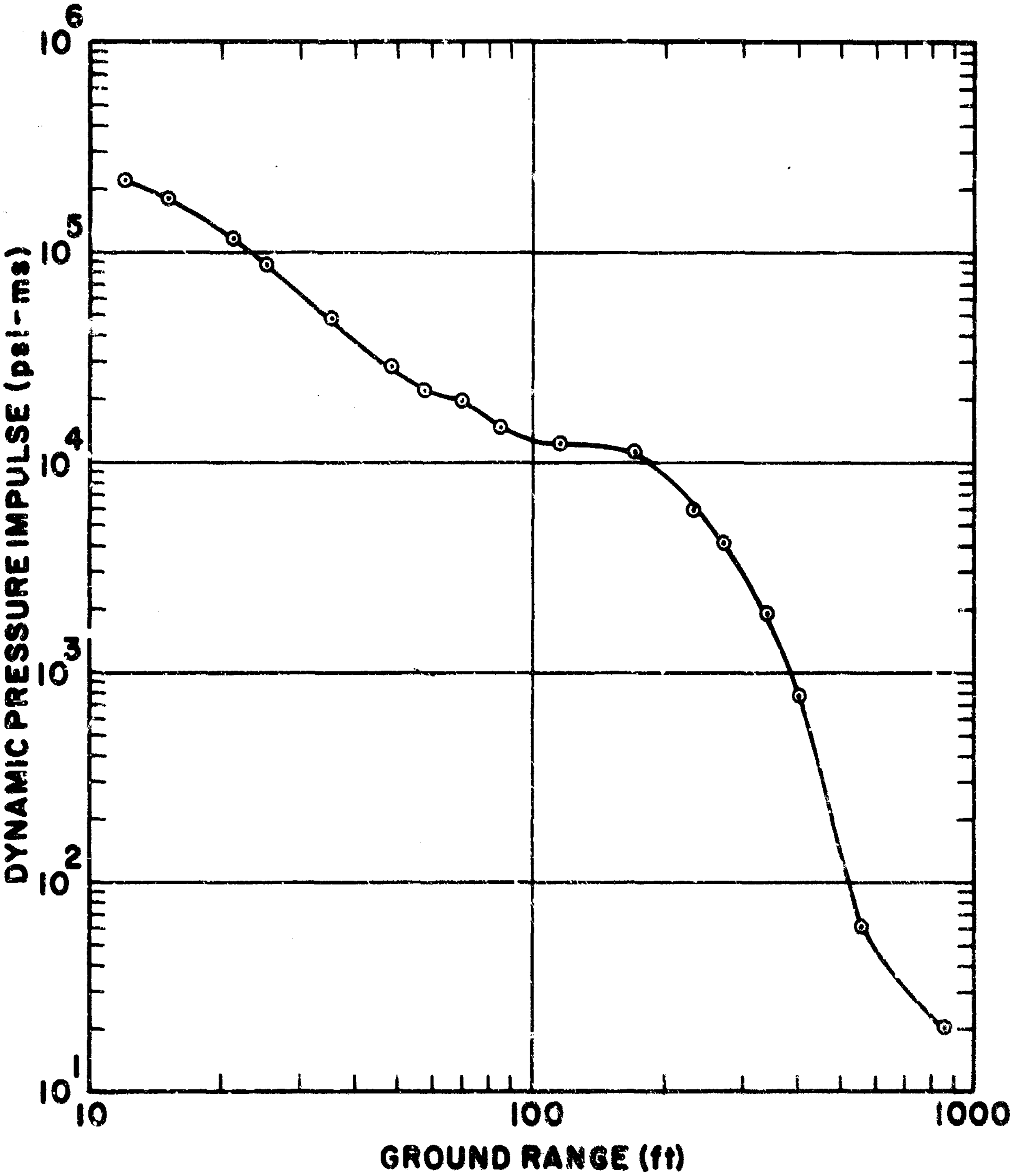


Figure 7. Dynamic Pressure Impulse vs. Ground Range.

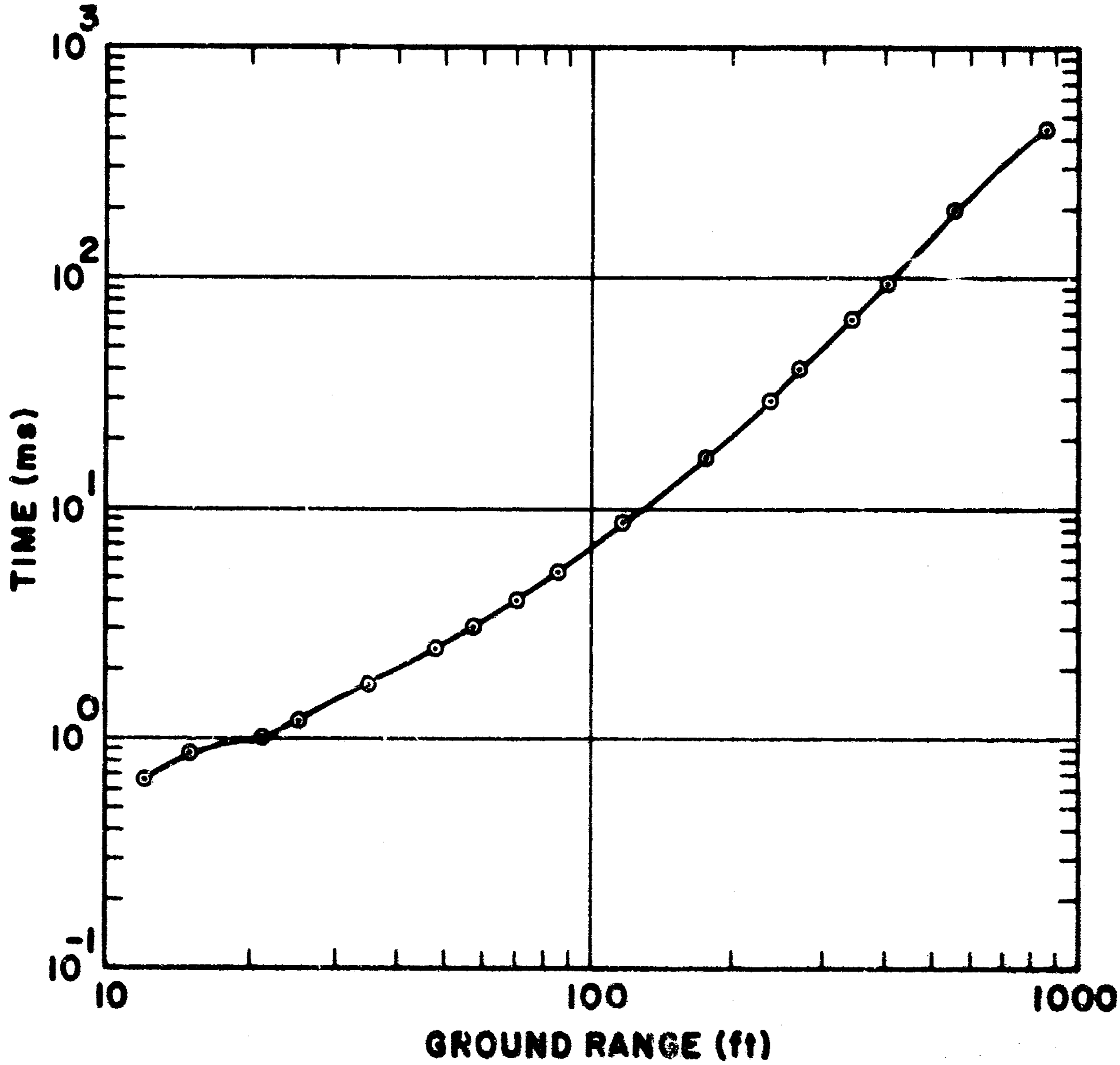


Figure 8. Arrival Time vs. Ground Range.

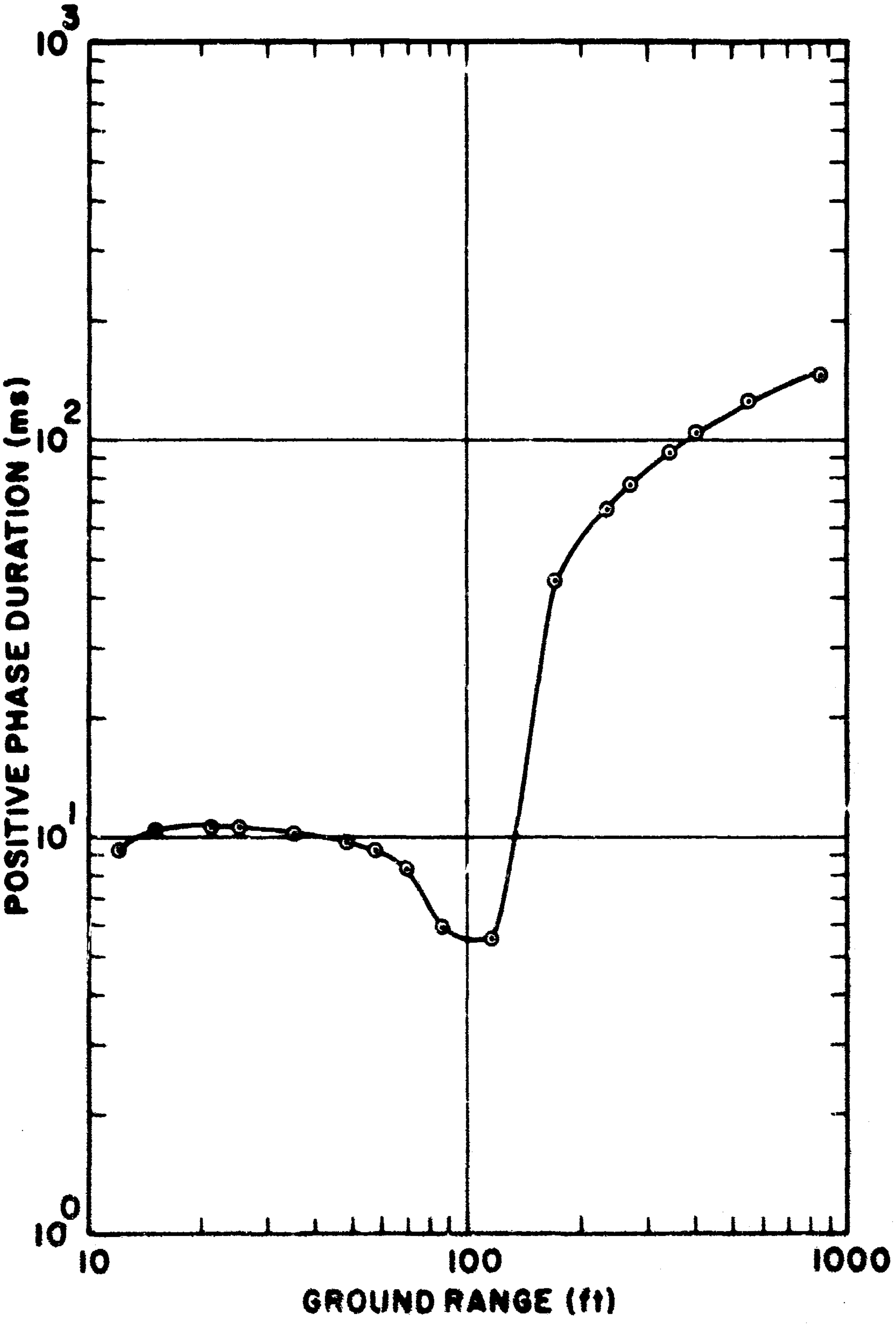


Figure 9. Positive Phase Duration vs. Ground Range.

in the detonation products just inside the TNT-air interface. It was initially very weak but gradually gained in strength. Because of the high expansion velocities, the second shock, though following the rarefaction wave into the detonation products, was initially moving outward in space. As the energy of the detonation products dissipated, the velocity of the second shock became larger than the velocity of the detonation products, and so the second shock began to move inward toward the center. This occurred at approximately 25 milliseconds. After this time the phenomenology no longer resembled that of free air as seen in the plots of appendix I.

The phenomenology for free air is fully documented in references 1 and 4.

2. <u>Effects of the Ground</u>

At the point of tangency the TNT detonation products could not expand nor could they reflect because the mass above was still moving outward. This caused a build-up in density and a corresponding rise in pressure along the ground with the only means of relief being a path outward, parallel to the surface of the ground. This motion and the resulting large horizontal velocities can be seen in the plots of appendix I as early as 0.5 millisecond. Along this path the detonation products expanded more rapidly than in any other direction, thus creating a "toe" to an otherwise spherically expanding shock wave. This toe became the dominating feature of the calculation and remained prominent to a time of 300 milliseconds. At this time the shock had reached a distance of approximately 700 feet. From this time on, the main shock front resembled that of a hemispherical surface detonation. By 500 milliseconds the toe was gone and the main shock front was approaching a spherically symmetric expansion.

Meanwhile the detonation products, driven by the large pressure-density gradients along the ground, accelerated outward until they reached the flow field immediately behind the outward-moving, toe-shaped shock (8 milliseconds). In this region the pressure gradients of the toe imparted a positive vertical velocity component to an otherwise horizontal flow field. Hence, the detonation products, after reaching the shock, passed vertically along its back edge into a region of smaller horizontal velocities. Other detonation products traveling along the ground with larger horizontal velocities passed underneath those products which were picked up. Therefore, the TNT-air interface formed a hook to the rear of the expanding shock along the ground. The structure of the toe was such that the peak pressure had its greatest radial extent along the ground, and the radial position of the peak decreased with altitude. Hence behind the

shock along the ground the flow field had negative vertical velocity components. This caused the detonation products which had been picked up to move back down again, thus forming a loop. The detonation products reached a radius of approximately 475 feet and a height of approximately 30 feet at a time of 500 milliseconds. The entire motion of the products can be seen in the plots of appendix I.

3. The Second Shock

Section 1 above describes the formation and movement of the second shock in the vertical direction. If this were a detonation in completely free air, this second shock would converge on the burst point and reflect there. It would subsequently travel outward to the TNT-air interface through which the second shock would be transmitted and a third shock would form there and travel inward repeating the process of the second shock. See reference 4. In this fashion a whole series of shocks would be propagated.

However, the presence of the ground in this calculation vastly modified this sort of phenomenology. The second shock front was very asymmetrical and became more so as time went on. Its motion was also asymmetrical and quite complicated. The plots of appendix I can describe the motion of the second shock front best.

A simplified version is as follows: The second shock starts its inward motion at the top near the outer edge of the detonation products. This inward motion of the second shock spreads to the adjoining portions of the shock front. The convergence of the shock on the center of burst is modified in such a way as to cause the shock to become nearly planar, pass vertically through the center of burst, and reflect from the ground.

4. Effect of the "Toe" on Blast Parameters

The blast parameters near the ground were drastically modified by the reflecting surface and subsequent formation of the toe. These effects were not simply close-in effects but remained important throughout the entire region of interest. Increased overpressures were noted, but of greater importance were the much higher dynamic pressures observed than would be expected from an equivalent yield hemisphere (Fig. 10). The increased dynamic pressures were further complicated by large vertical components of velocity and dynamic pressure, caused by the increased pressure of the material near the ground accelerating the region above it. This is contrary to expectations for a hemispherical configuration of the shock which would have negligible vertical velocities. The vertical velocities near the ground at the shock front are positive giving the shock an

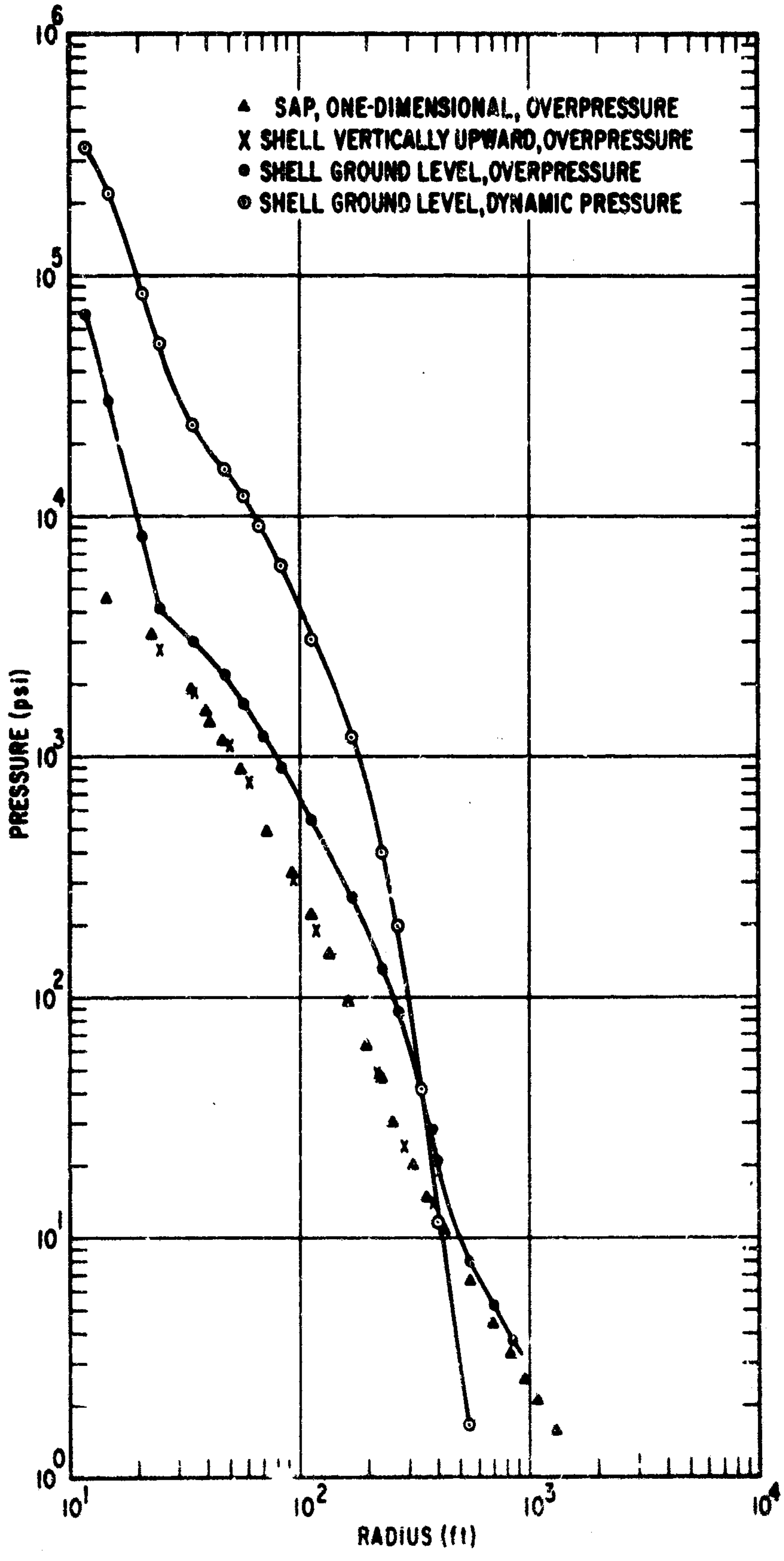


Figure 10. Overpressure and Dynamic Pressure vs. Radius.

inclination of over 15 degrees to the vertical, to a radius of over 350 feet. Somewhat behind the shock front is a region of negative vertical velocities causing a sudden reversal of the vertical flow at any point within several meters of the surface. This effect can be seen in the vertical velocity and vertical dynamic pressure station plots of Appendix II.

The toe did not allow normal shock formation until it had reached a radius of approximately 150 feet and by 200 feet the shock was well formed. At about 150 feet a sudden change occurred in positive phase duration and was the most dramatic indication of normal shock formation. At this same radius similar deviations from a smooth curve are noted in all other variables.

Beyond the 200-foot radius the shock retains some of the characteristics imparted to it by the toe of the detonation products.

The parameters appearing in this report were taken directly from the computer output. No extrapolation was used in either overpressure, dynamic pressure, or radius. Extrapolation was considered neither important nor significant over the greatest portion of the region of interest. Extrapolation procedures have been used on previous occasions (Ref. 1) and the effect of extrapolation can be accurately predicted.

The overpressures to a radius of 300 feet should be within experimental error. Beyond this radius the peak overpressure drops somewhat below the expected overpressures, and by 600 feet are about 10 percent low.

The one-dimensional SAP calculation has sufficient resolution that extrapolation is not necessary. Figure 10 includes a comparison of the SHELL, vertically upward, and the SAP calculation. To a radius of 400 feet no significant deviation is noted.

SECTION IV

CONCLUSIONS

This calculation shows that asymmetries in the flow field as characterized by the "toe" moving along the ground will be a dominant feature of DISTANT PLAIN Event 6 phenomenology. These asymmetries will be present throughout the period of interest (0.5 ms to 300 ms), a much longer time than previously anticipated (Ref. 5).

One should also expect higher overpressures, higher velocities, and higher dynamic pressures farther out along the ground because of the longer duration of these asymmetries. Large vertical velocity and dynamic pressure components will be associated with this toe just above the ground and extending in altitude to the unperturbed portion of the shock front.

The calculation reported here treated the ground as a perfectly reflecting plane. However, this will not entirely be the case in the experiment. Some of the blast energy will be transformed into ground motion and crater formation. This energy may be as high as 10 to 15 percent. So the actual effects of the ground will modify the phenomenology reported here. However, these calculations provide an upper limit of what can be expected.

APPENDIX I

PRESSURE AND DENSITY CONTOURS AND VELOCITY VECTOR PLOTS

Appendix I contains pressure and density contours and velocity vector plots giving a detailed history of the calculation.

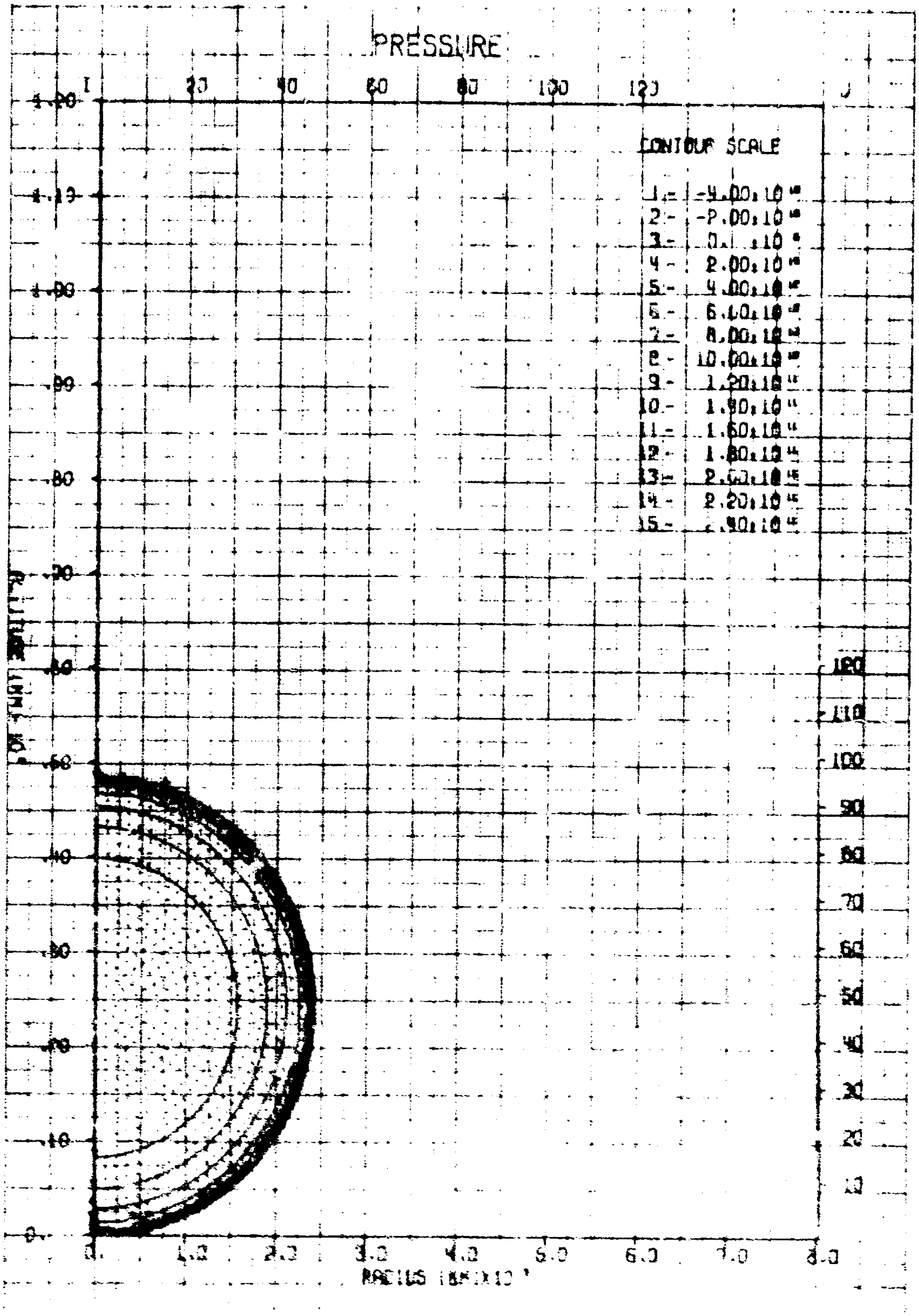
On all graphs, the integers along the top are the indices of the computational mesh in the radial direction. The integers along the right are the indices in the axial direction. The computational mesh of 123 × 121 (axial × radial) cells indicates the active portion of the mesh. The altitude scale gives the height above ground.

On all graphs, the dots represent the location of the TNT detonation products. The heavily dotted curve, which in these graphs appears as a thick, solid curve, represents the TNT-air interface.

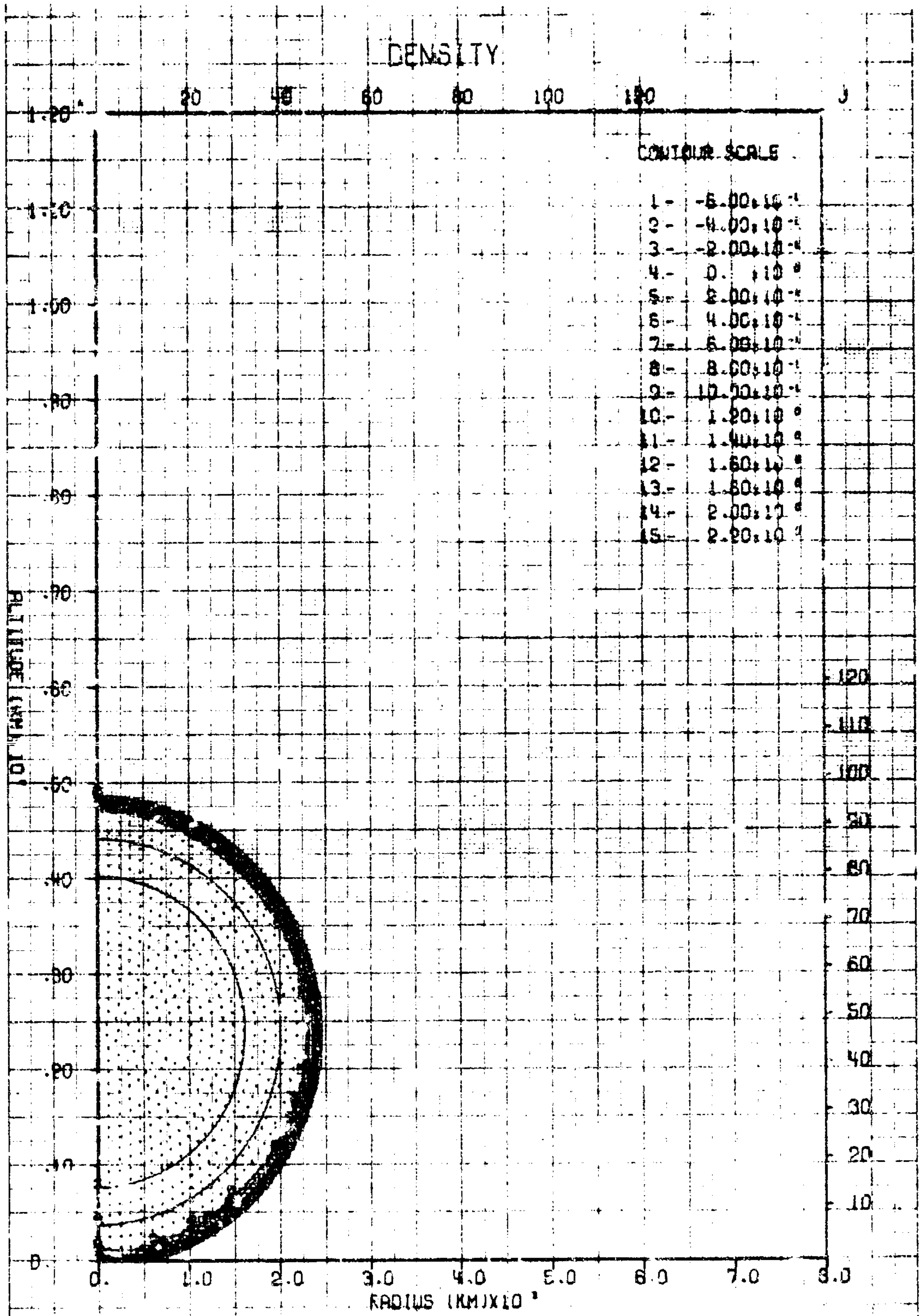
On the pressure contours, each line connects points of constant pressure. Each line has a number which corresponds to a value of pressure in dynes/cm^2 given in the contour scale.

On the density contour, each line connects points of constant density. Each line has a number which corresponds to a value of density in gms/cm^3 given in the contour scale.

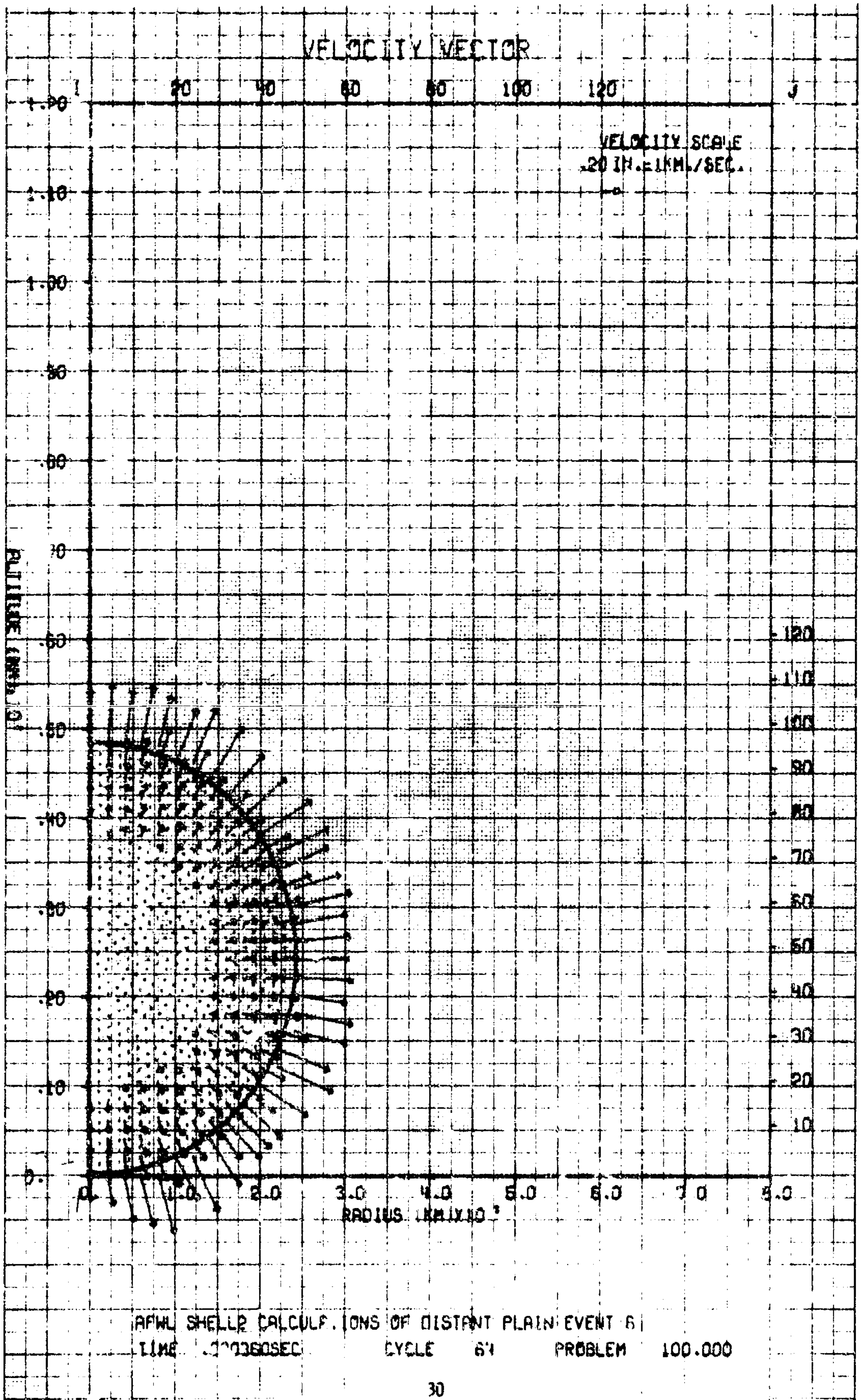
The velocity vectors in the velocity vector plots give the magnitude and direction of the velocities present in the field. The velocity scale appearing in the upper right-hand corner of each plot corresponds to the magnitude of each vector in a plot. The tail of each vector is located at the center of the cell. The direction of the arrow indicates the direction of the velocity.

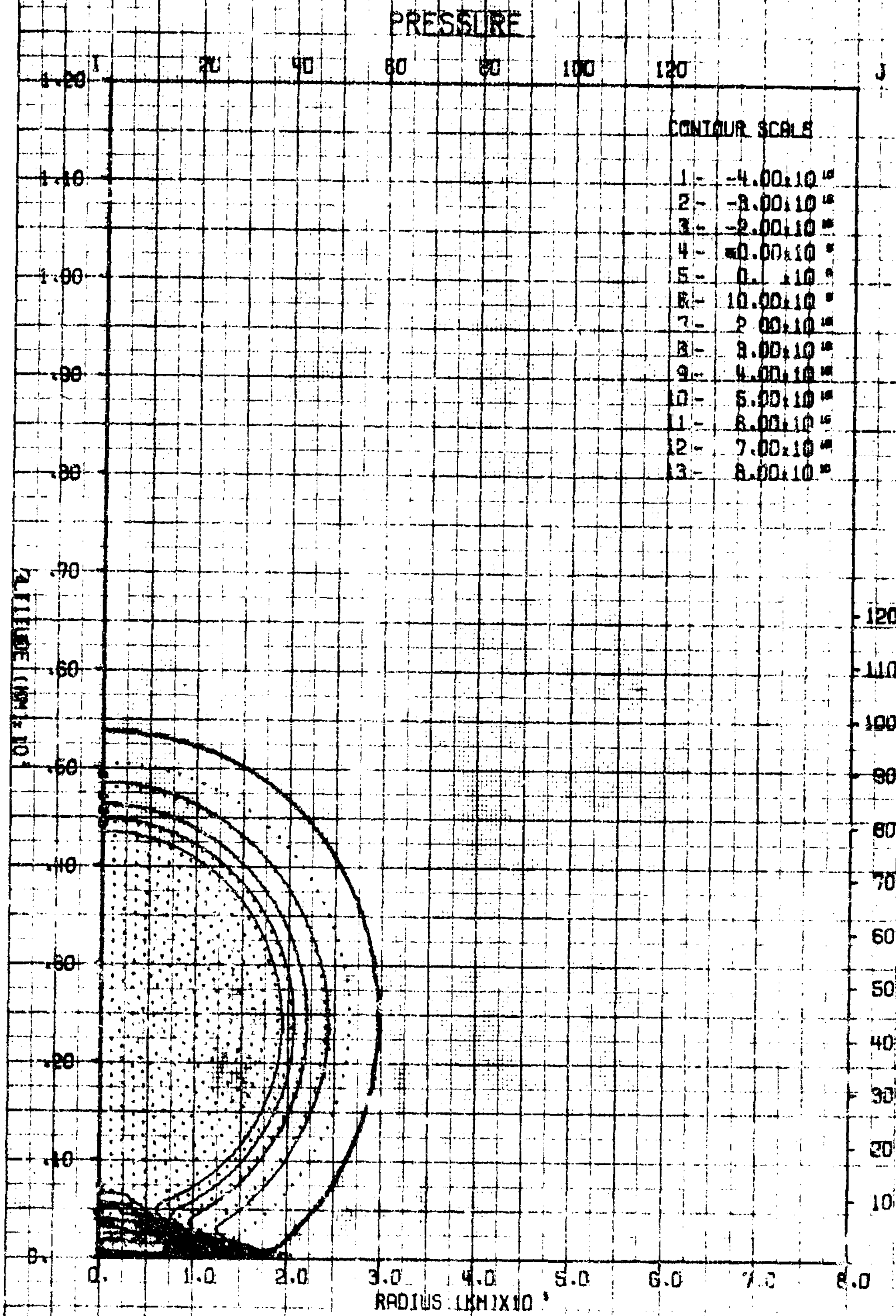


[illegible] SHELLS CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .00036 SEC CYCLE 64 PROBLEM [illegible]



AFWL CHELL2 CALCULATIONS OF DISTAN, PLAIN EVENT 6
TIME .00380SEC CYCLE 64 PROBLEM 100.000


VELOCITY VECTOR
I
20
40
60
80
100
120
J
VELOCITY SCALE
.20 IN.=1KM/SEC.
ALTITUDE (KM)
120
110
100
90
80
70
60
50
40
30
20
10
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
RADIUS (KM)
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME
CYCLE
PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
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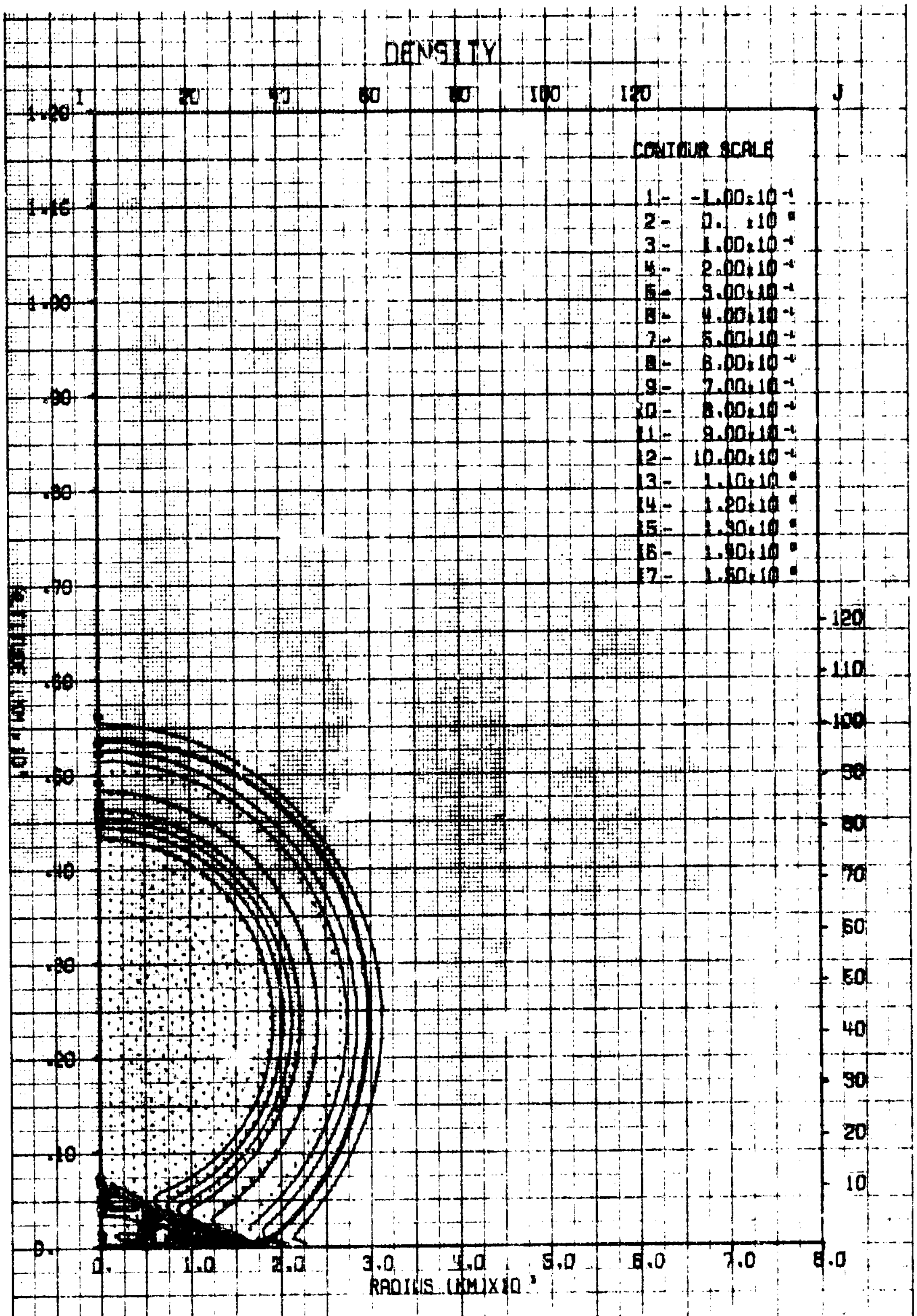
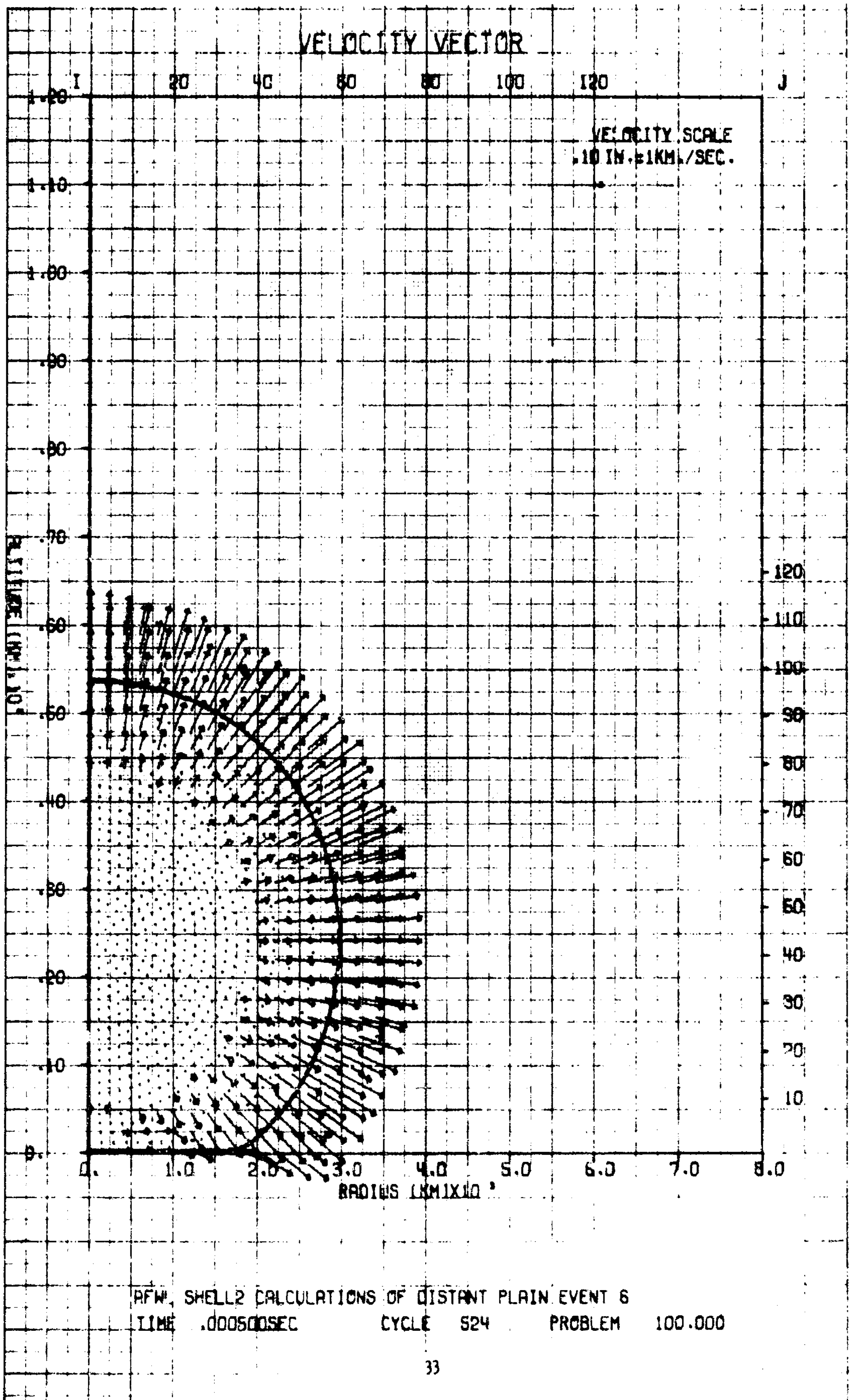
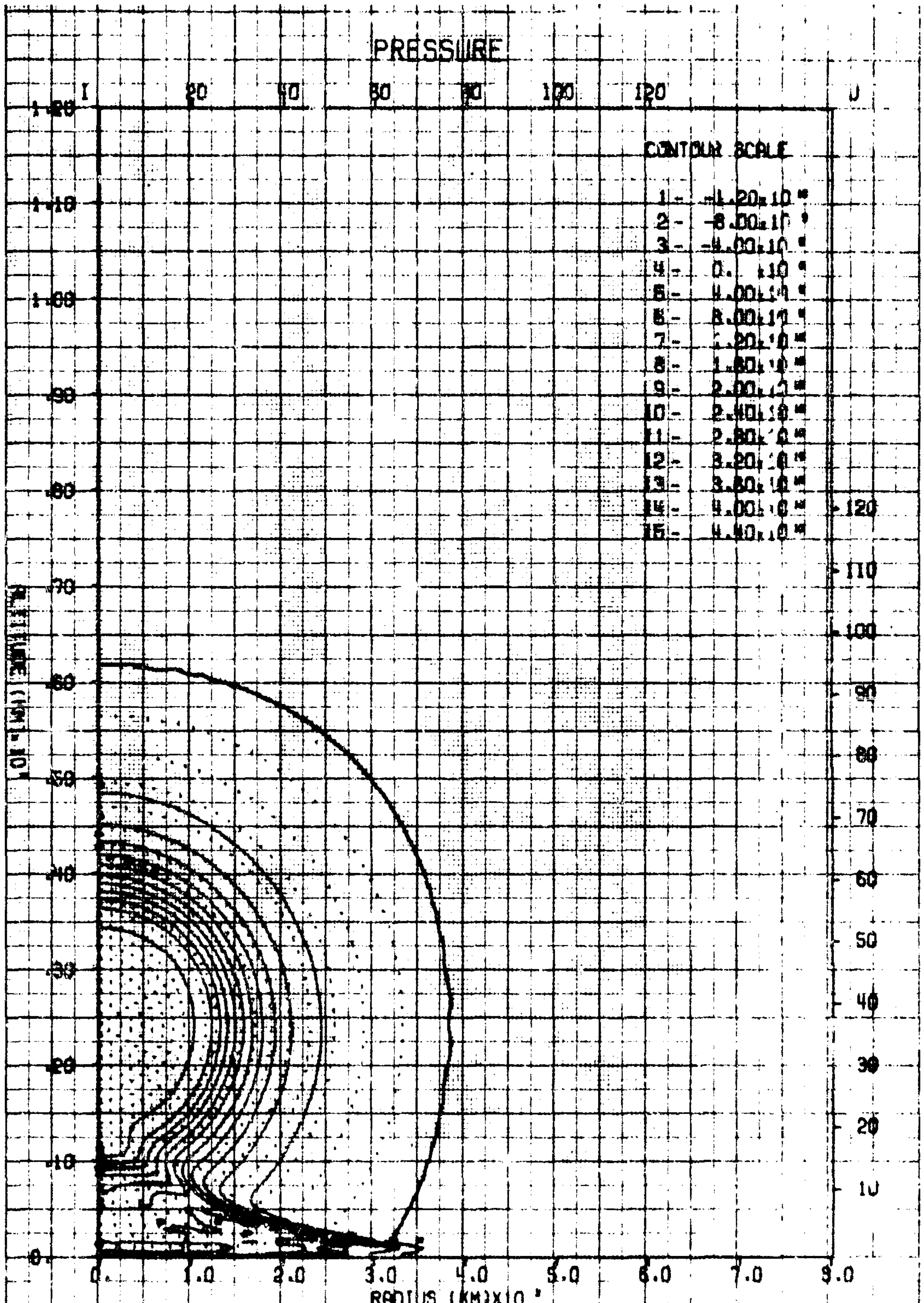


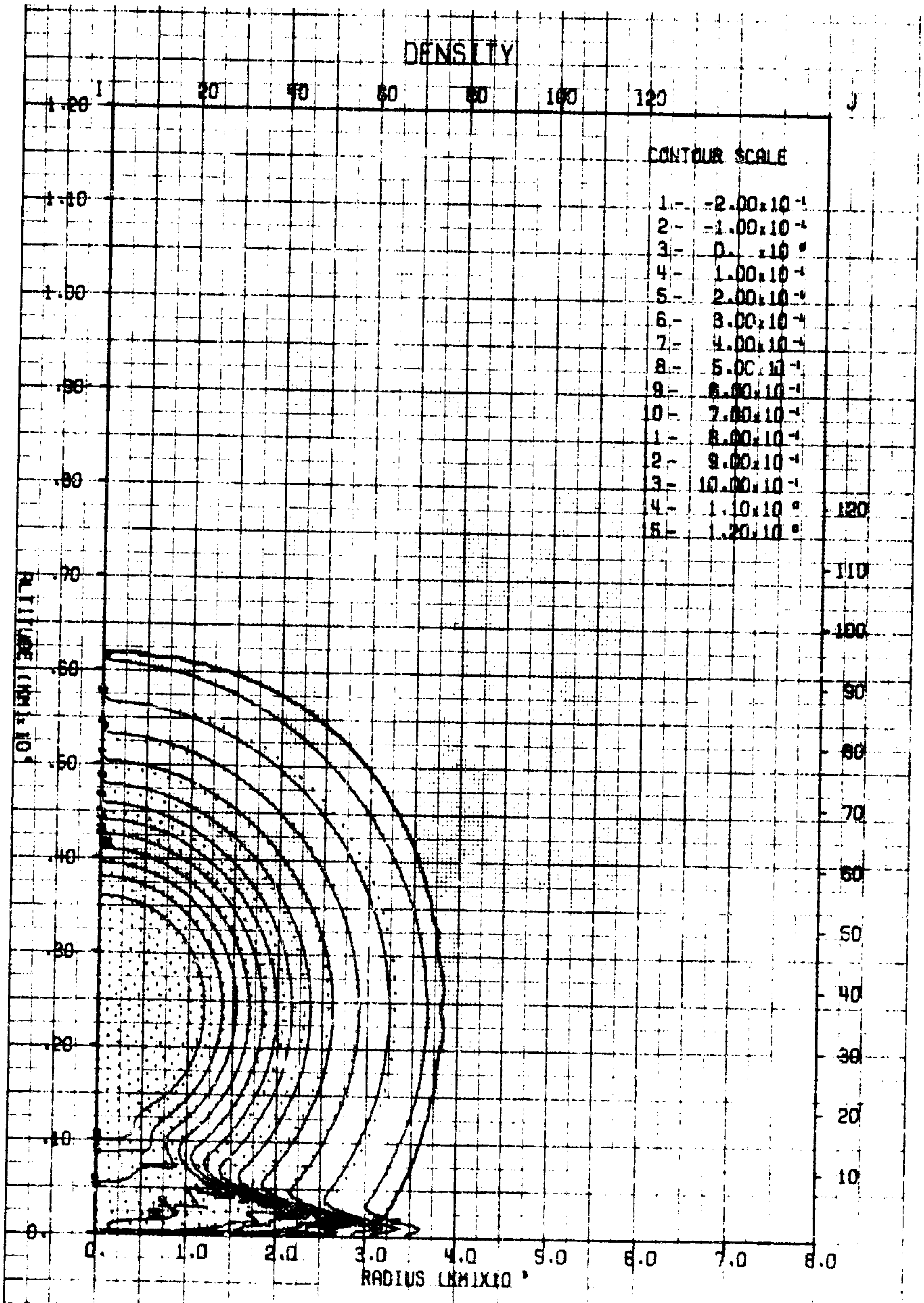
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

TIME .000500SEC CYCLE 524 PROBLEM 100.000


VELOCITY VECTOR
VELOCITY SCALE
.10 IN.=1KM./SEC.
RADIUS (KM)X10
ALTITUDE (KM) X 10
RFW, SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .000500SEC CYCLE 524 PROBLEM 100.000

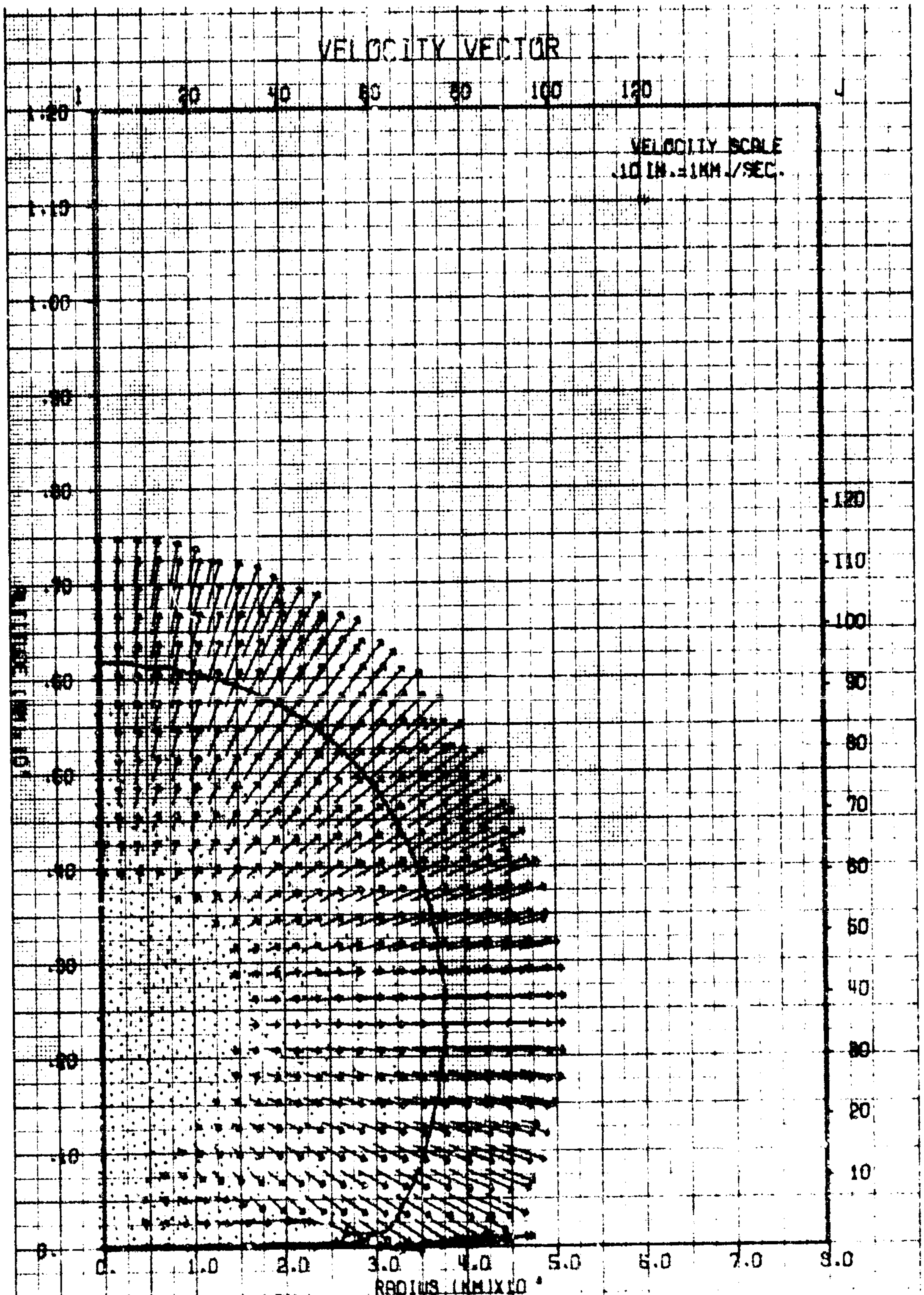


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .000700SEC CYCLE 781 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

TIME .000700SEC CYCLE 781 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
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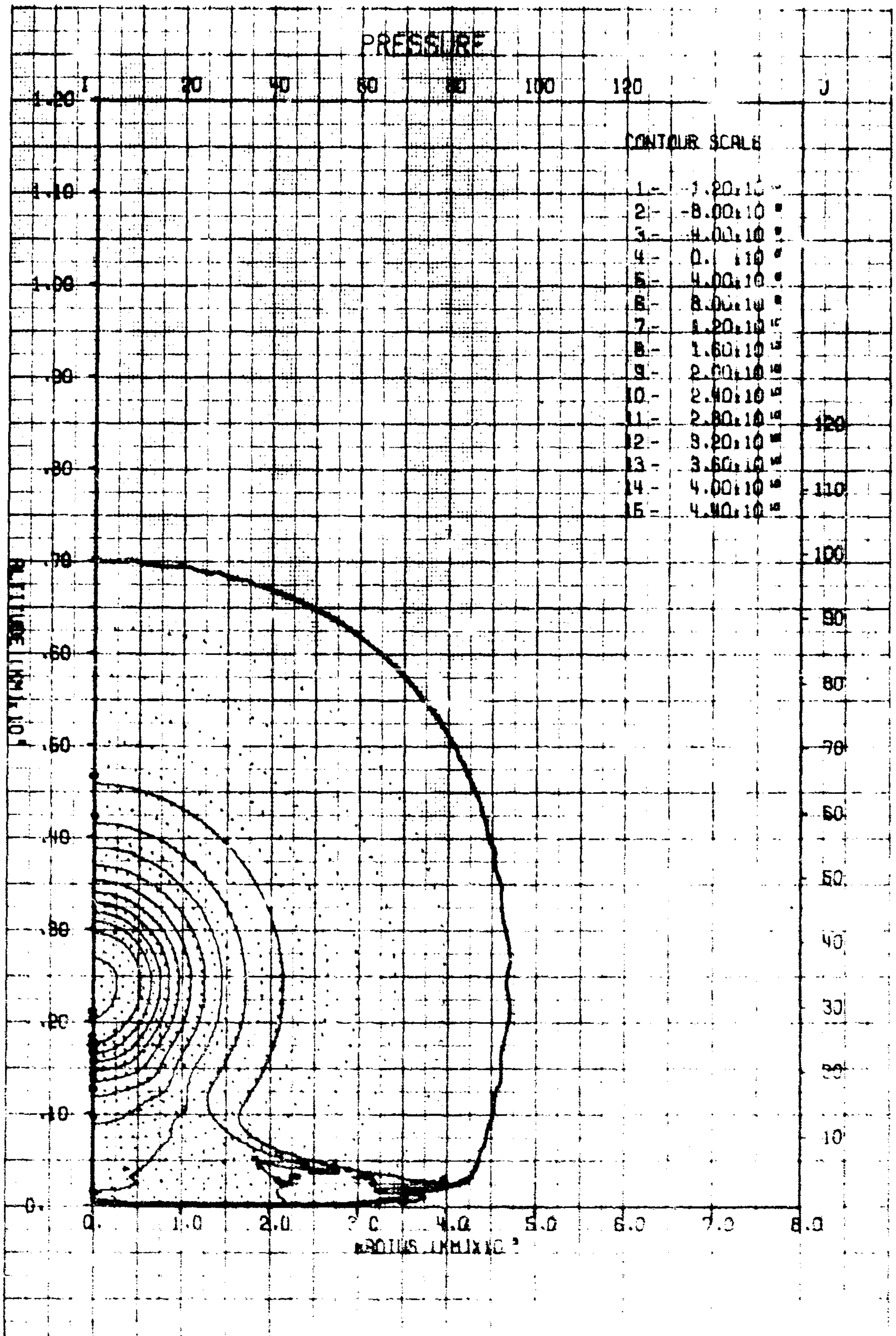
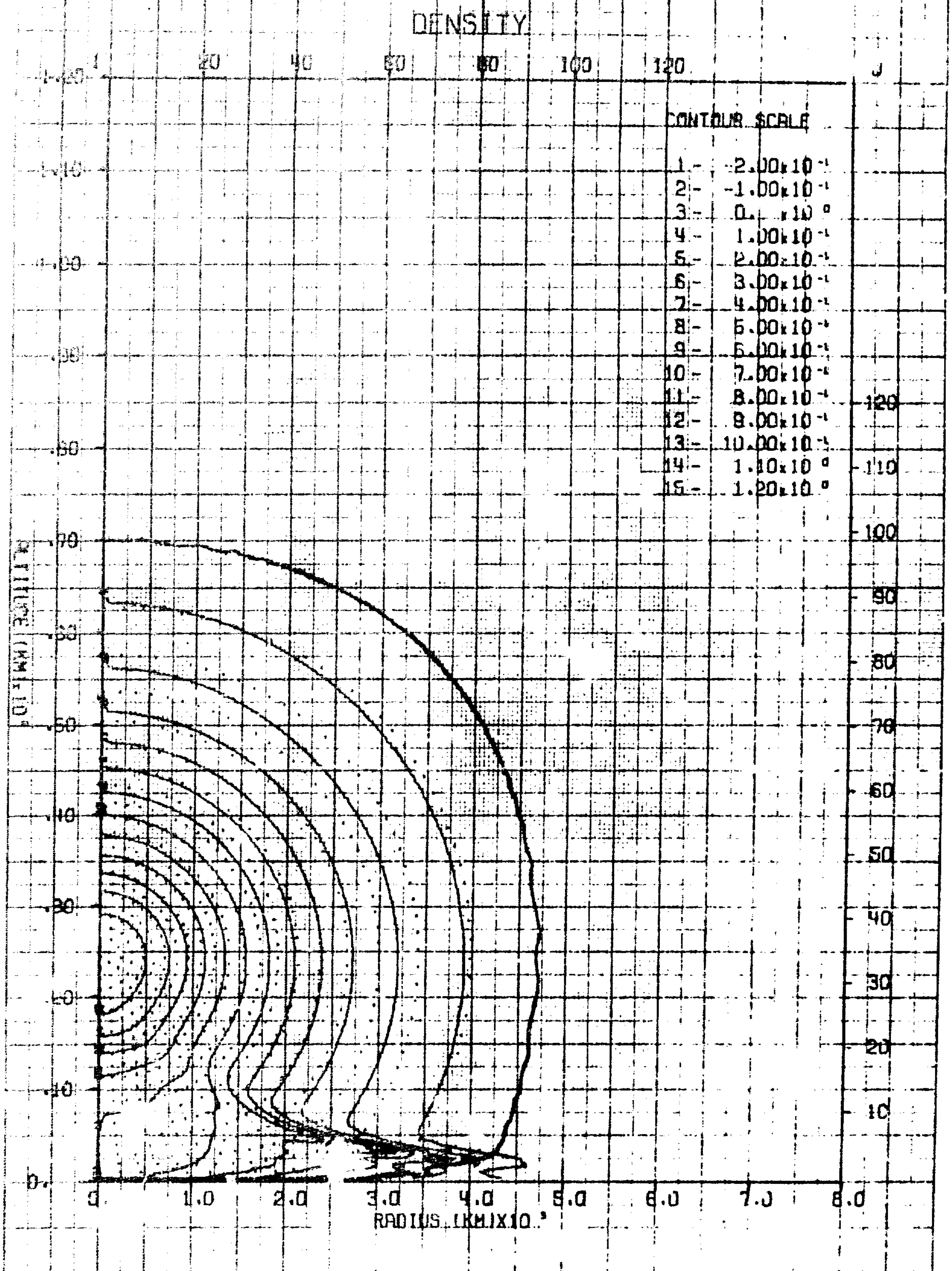


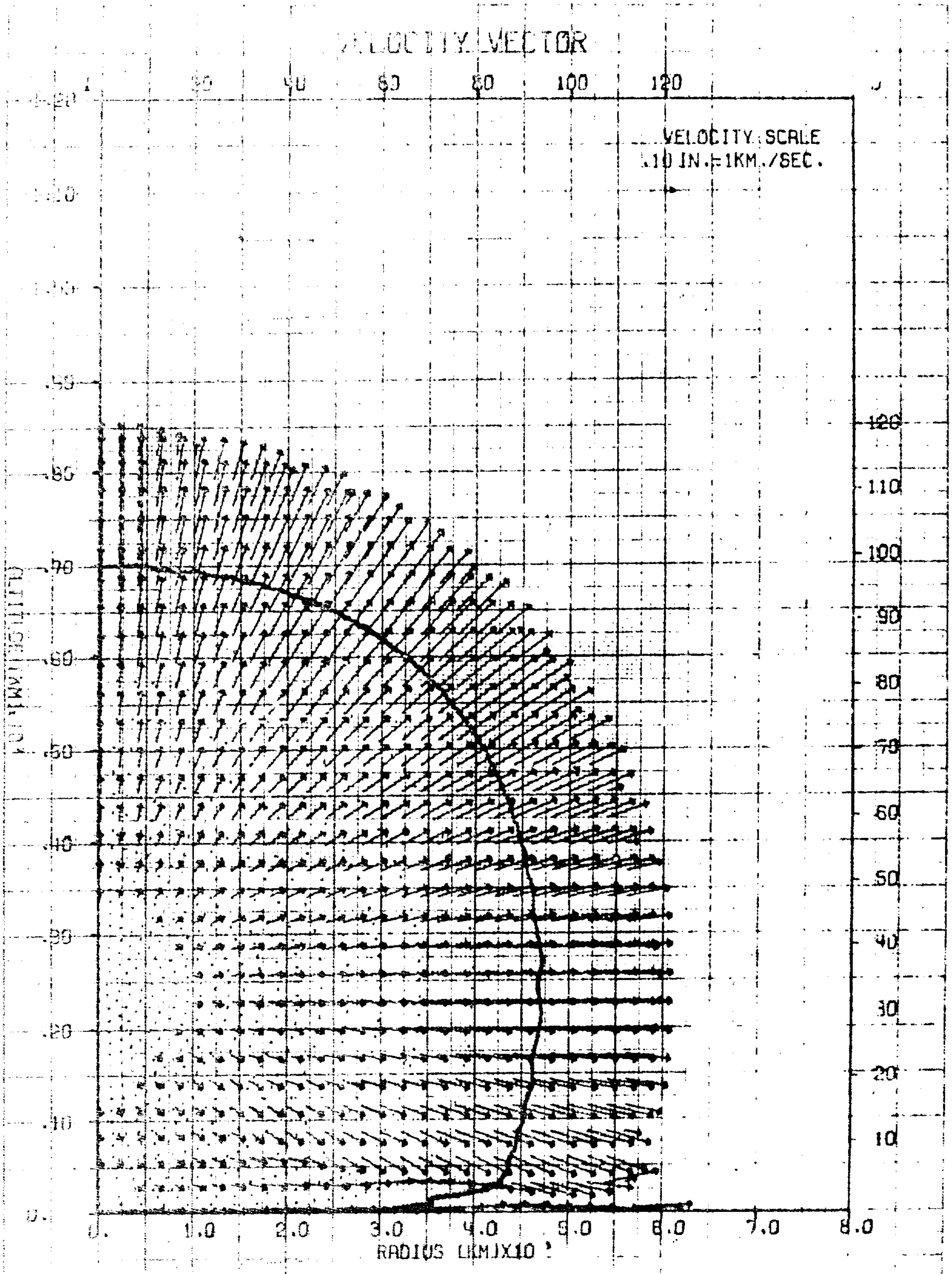
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

TIME .00392 SEC CYCLE 1017 PROBLEM 100.002



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

TIME .000300SEC CYCLE 1017 PROBLEM 100.000



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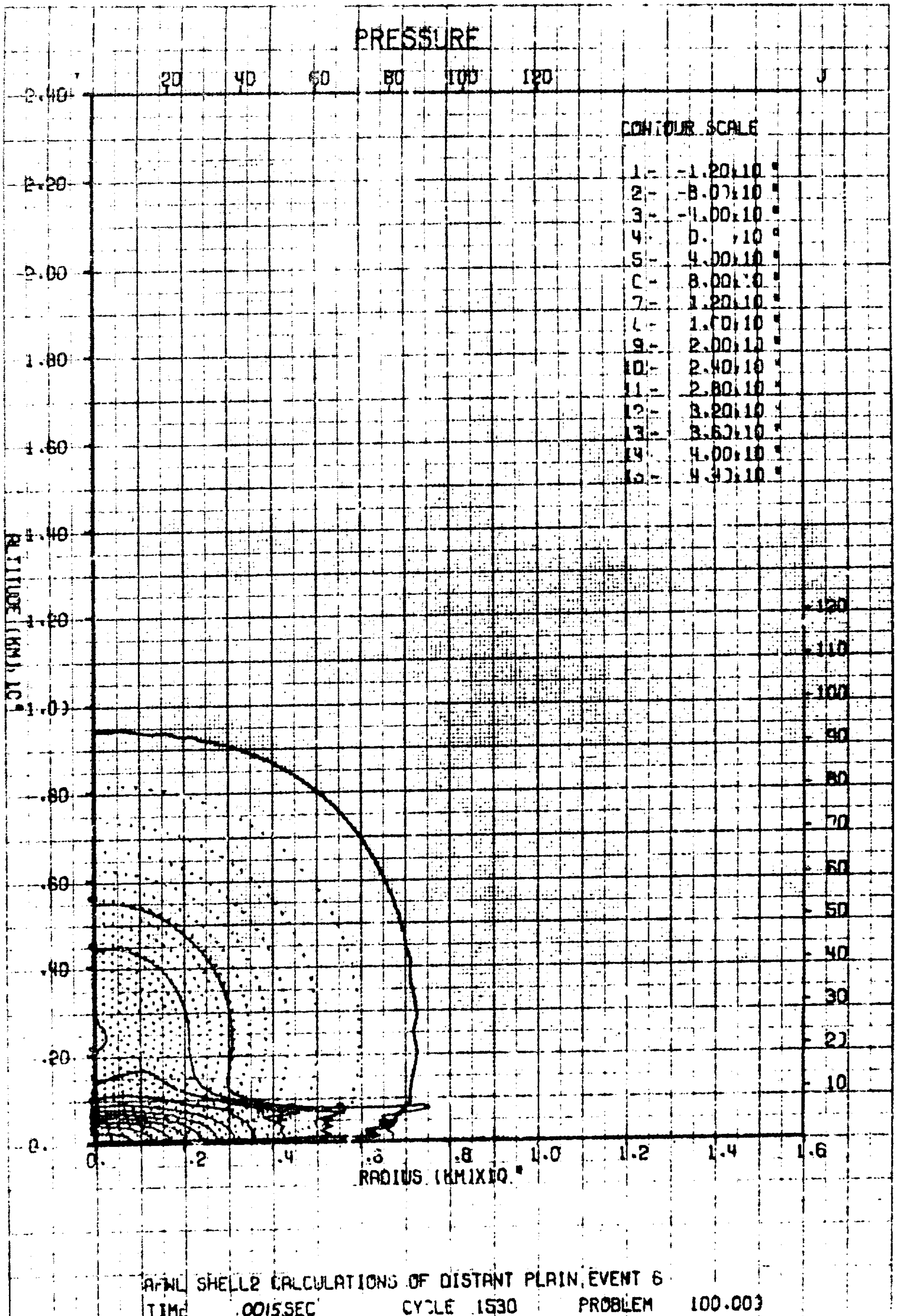
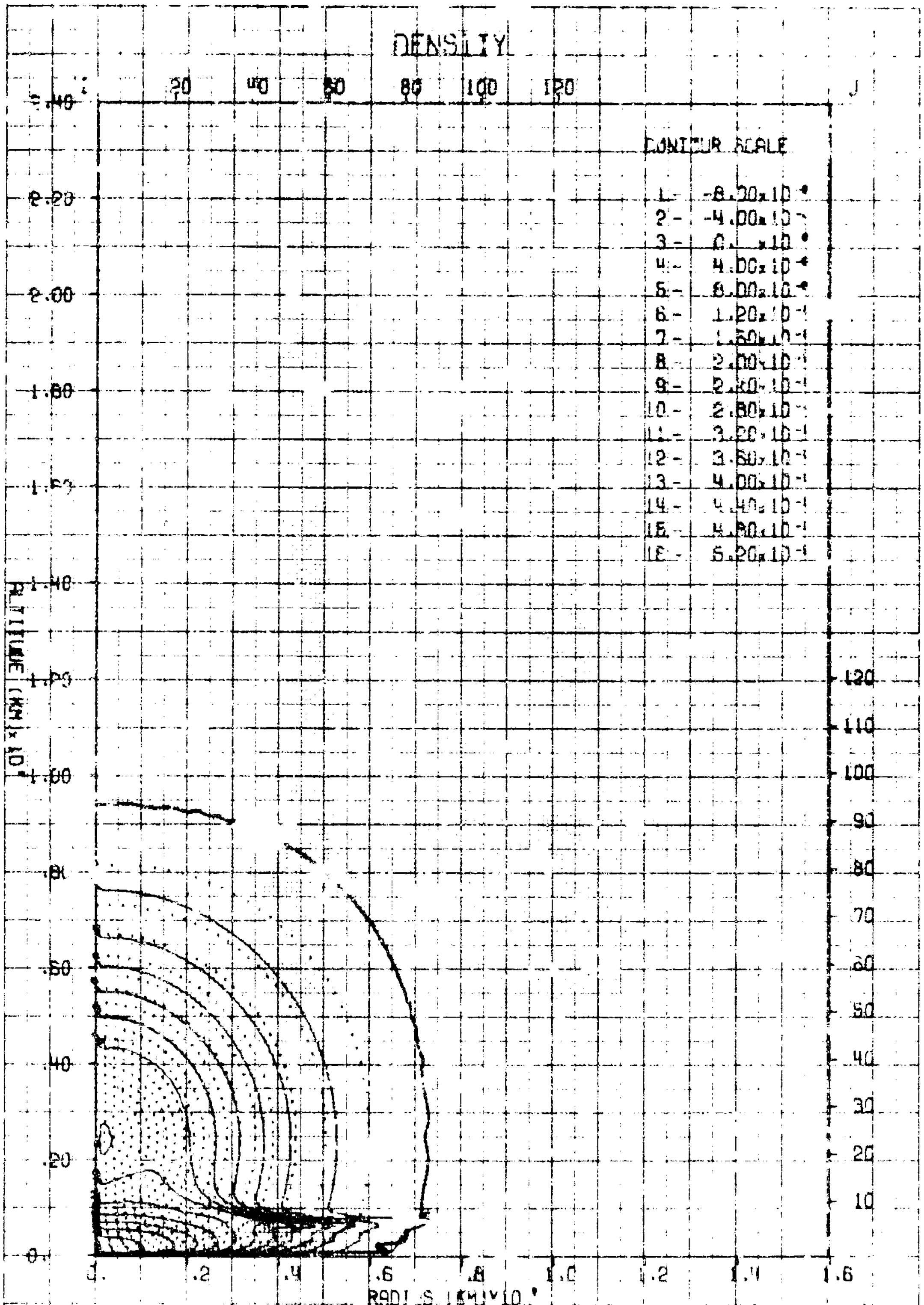
TIME .00000SEC CYCLE 1017 PROBLEM 100.000


PRESSURE
20 40 60 80 100 120 J
CONTOUR SCALE
1 - -1.20 10
2 - -8.00 10
3 - -4.00 10
4 - 0. 10
5 - 4.00 10
6 - 8.00 10
7 - 1.20 10
8 - 1.60 10
9 - 2.00 10
10 - 2.40 10
11 - 2.80 10
12 - 3.20 10
13 - 3.60 10
14 - 4.00 10
15 - 4.40 10
ALTITUDE (KM) 10
RADIUS (KM)X10
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN, EVENT 6
TIME .0015SEC CYCLE 1530 PROBLEM 100.003



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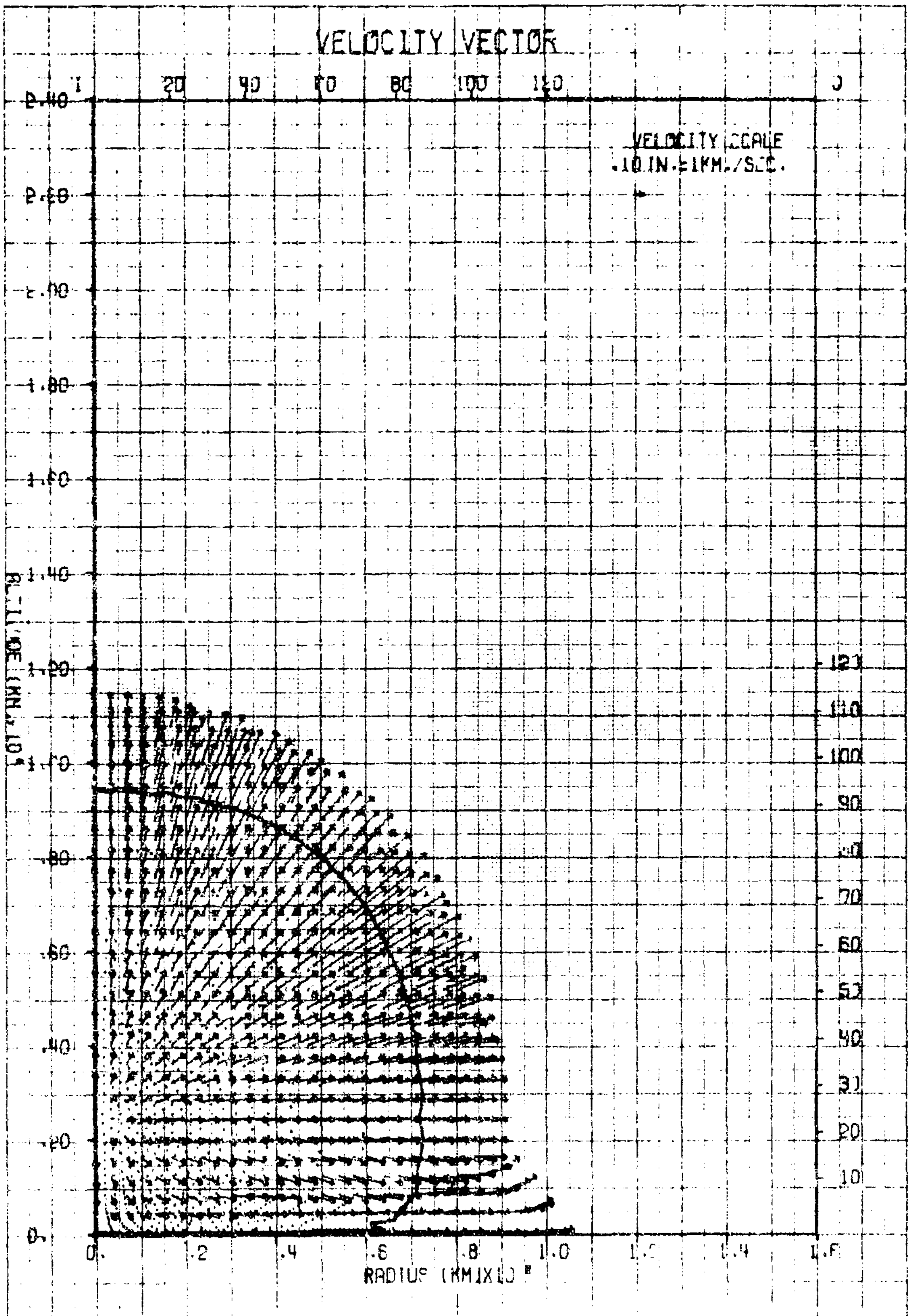
TIME .0015SEC CYCLE 1530 PROBLEM 100.000



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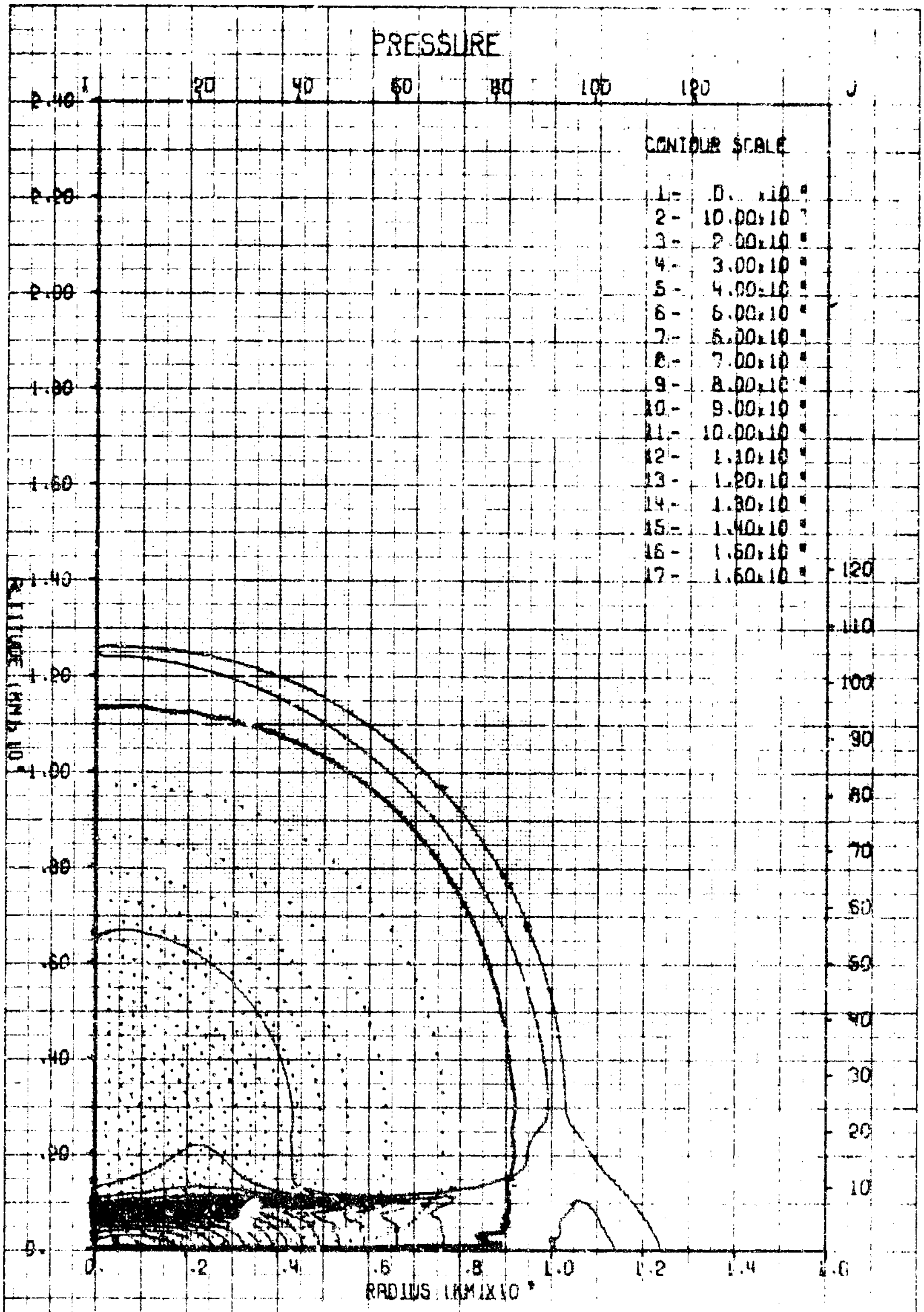
TIME .0015SEC CYCLE 1530 PROBLEM 100.000



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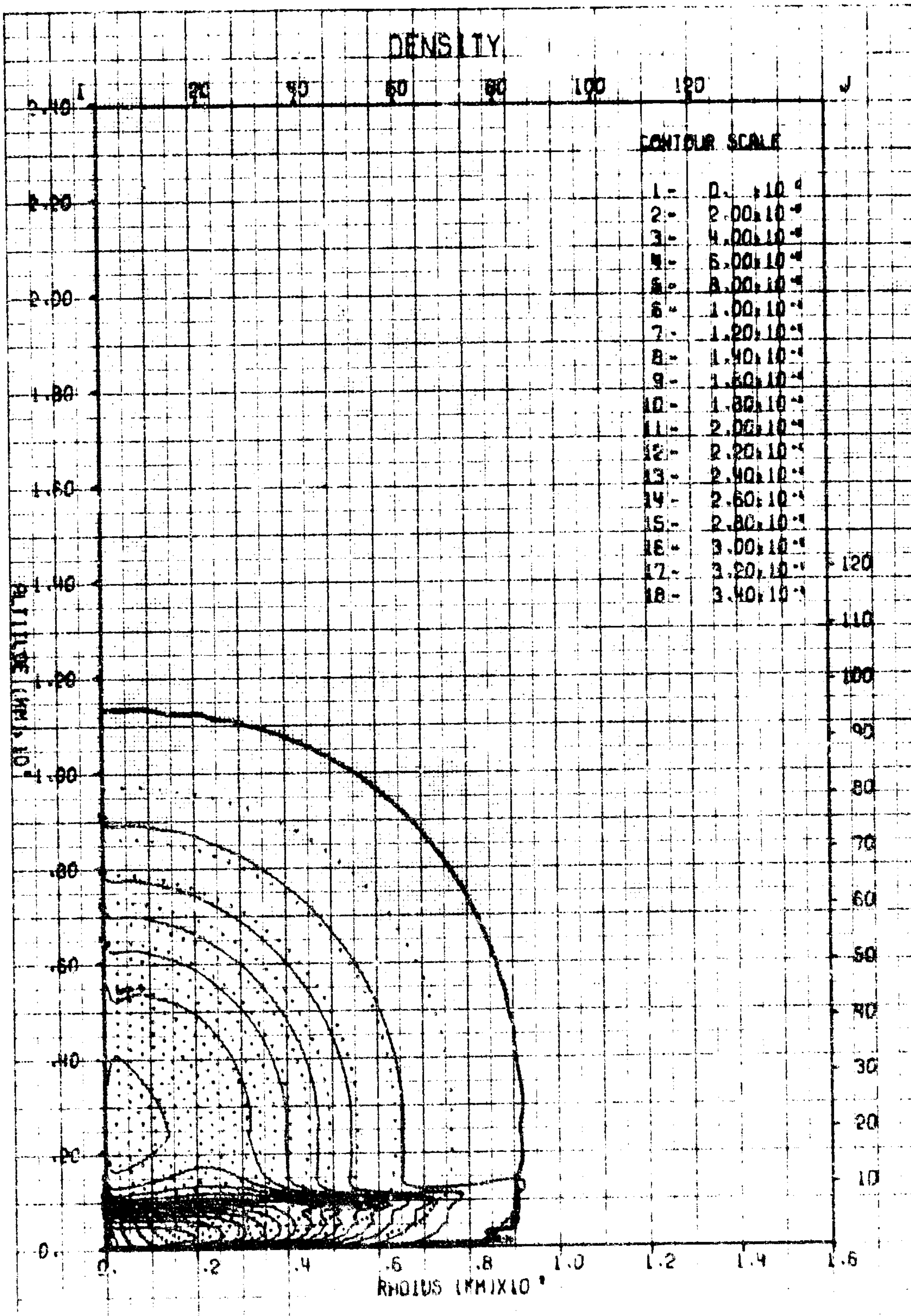

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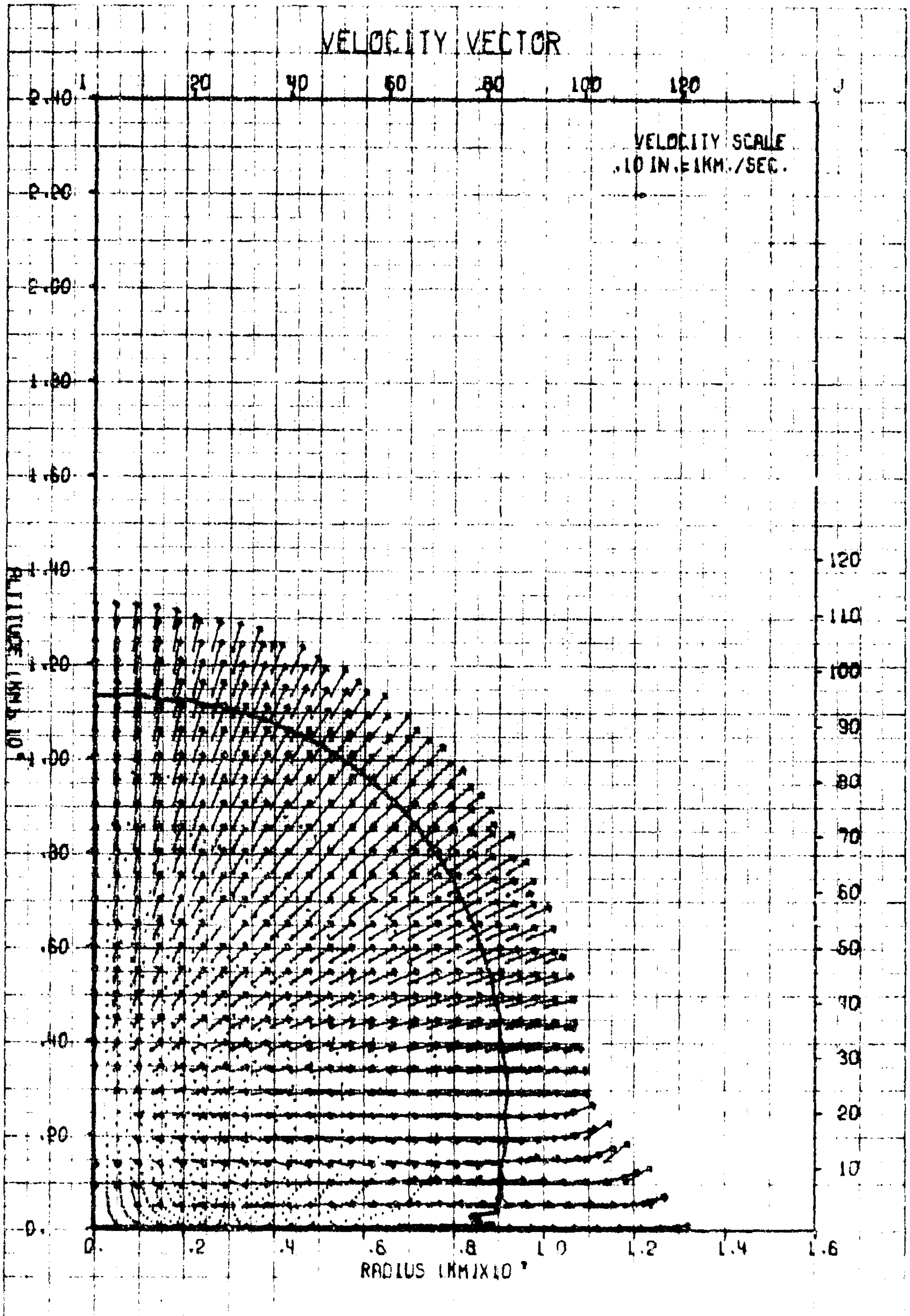

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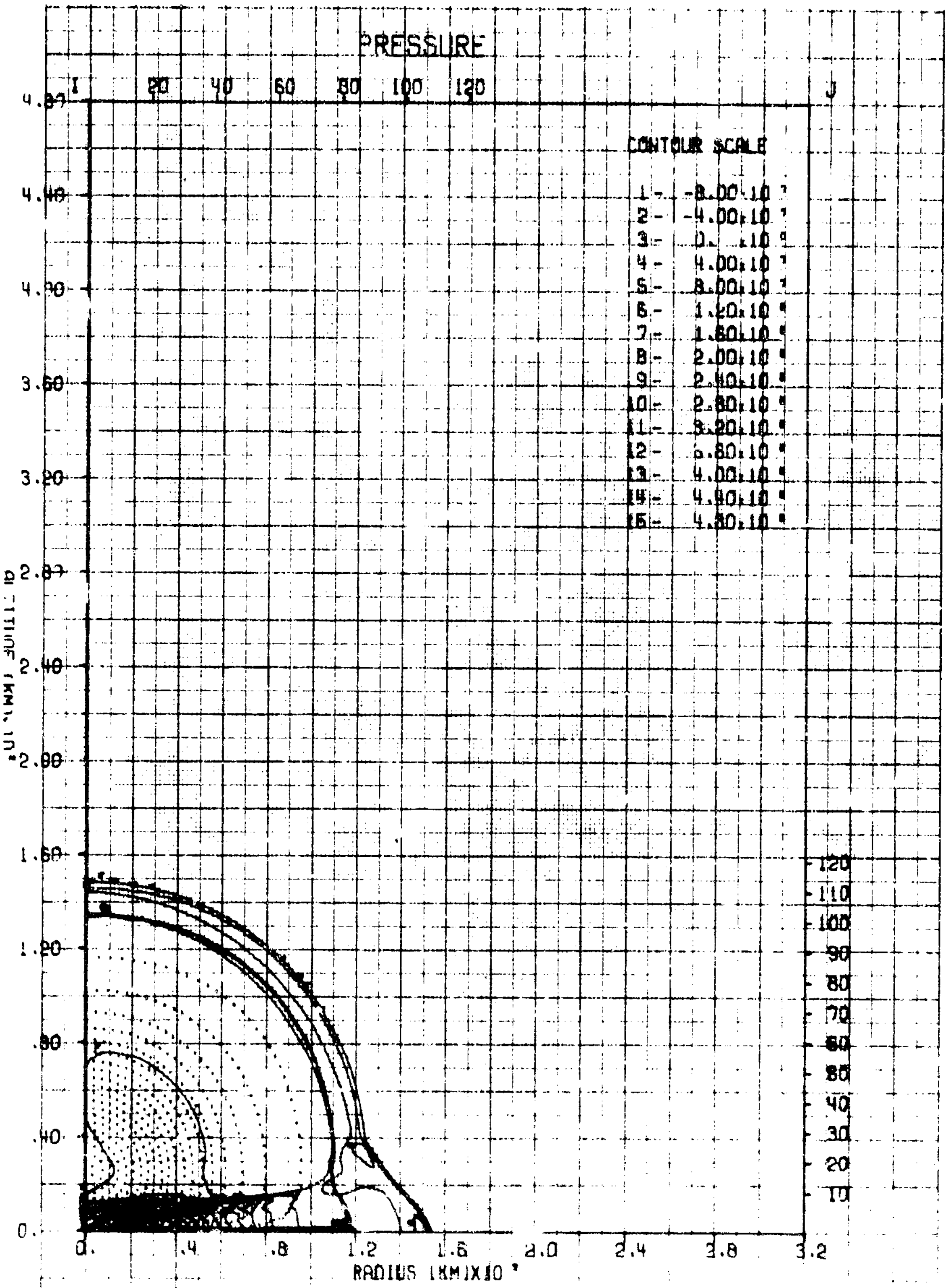

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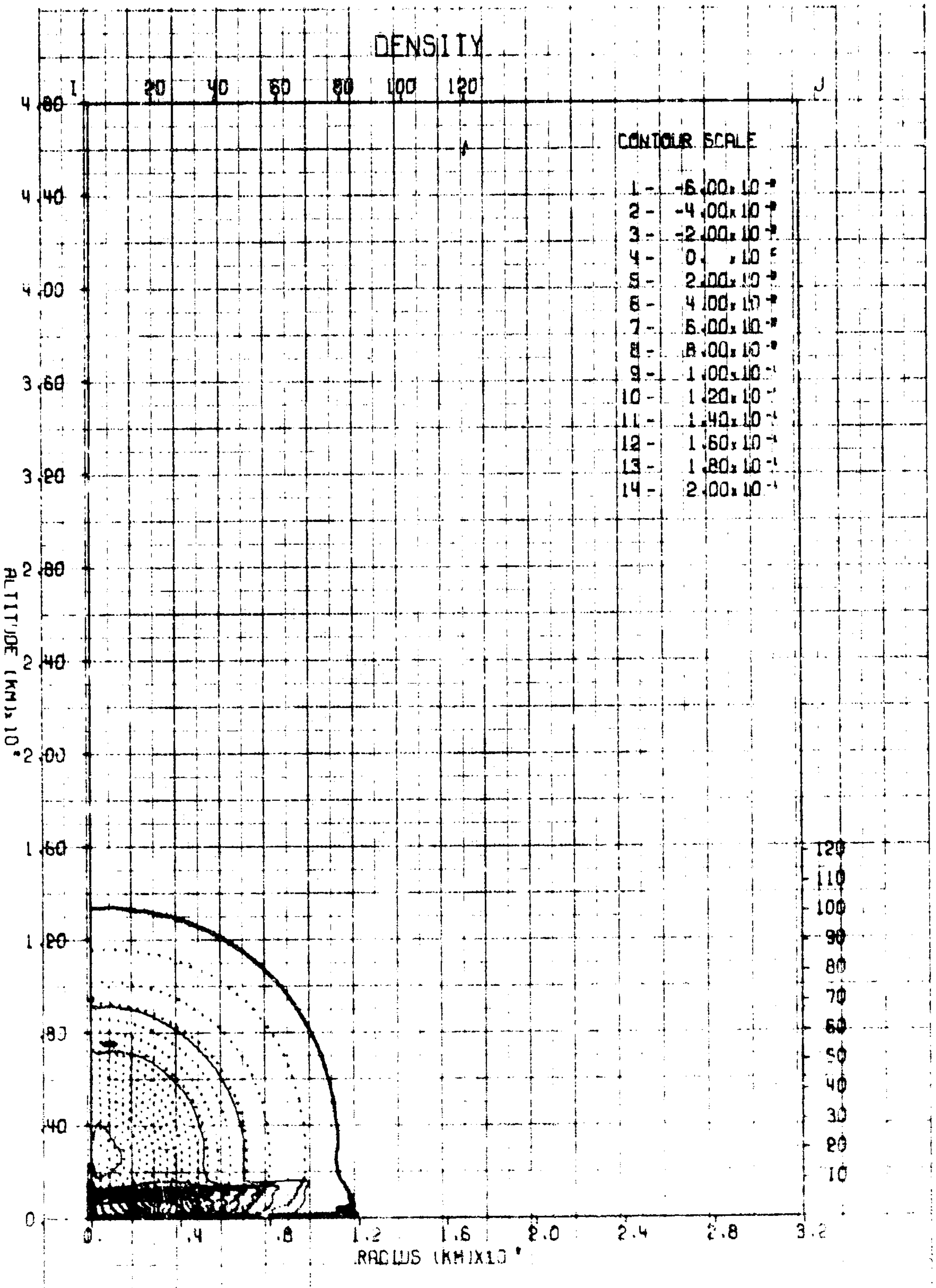

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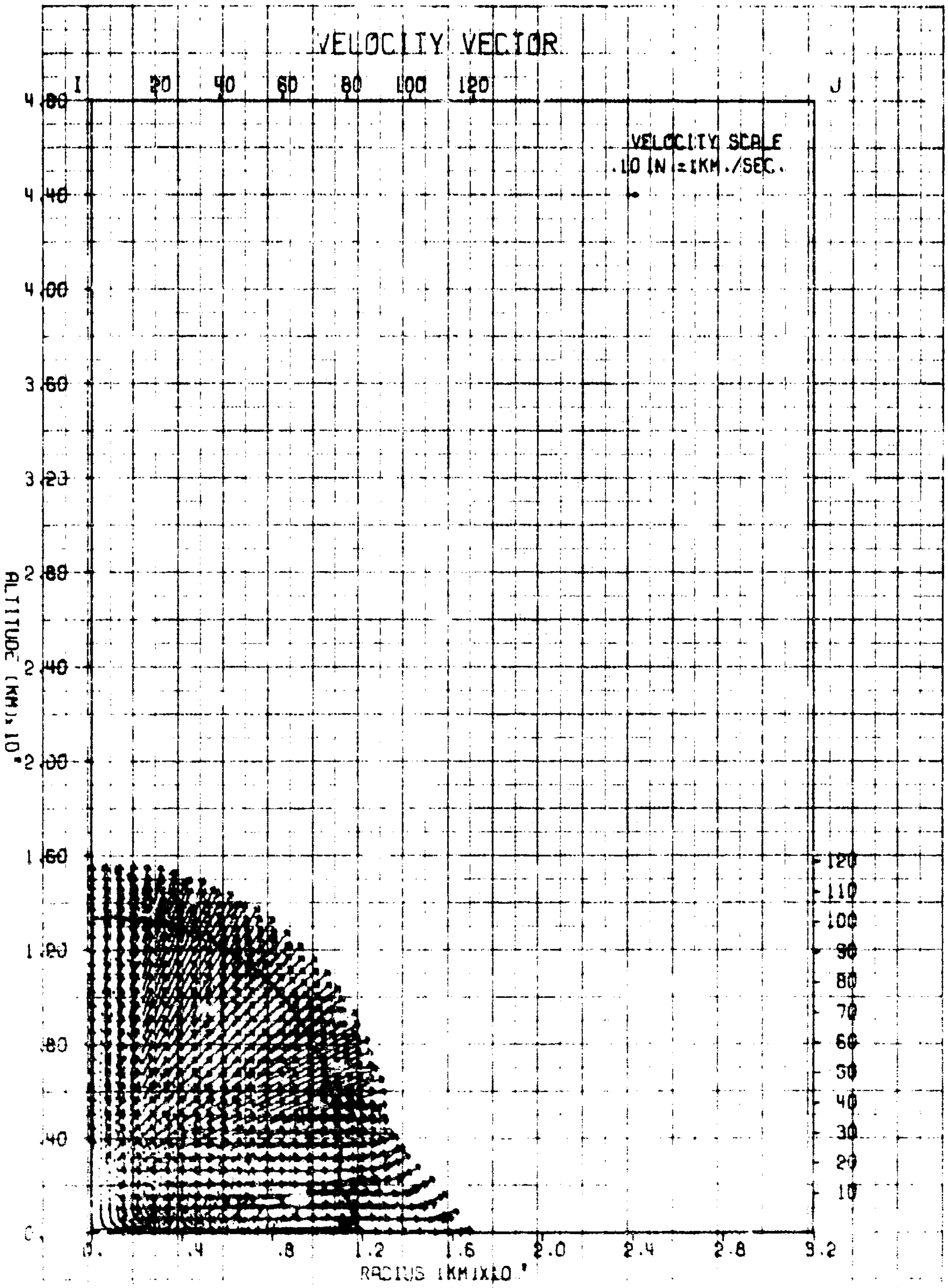

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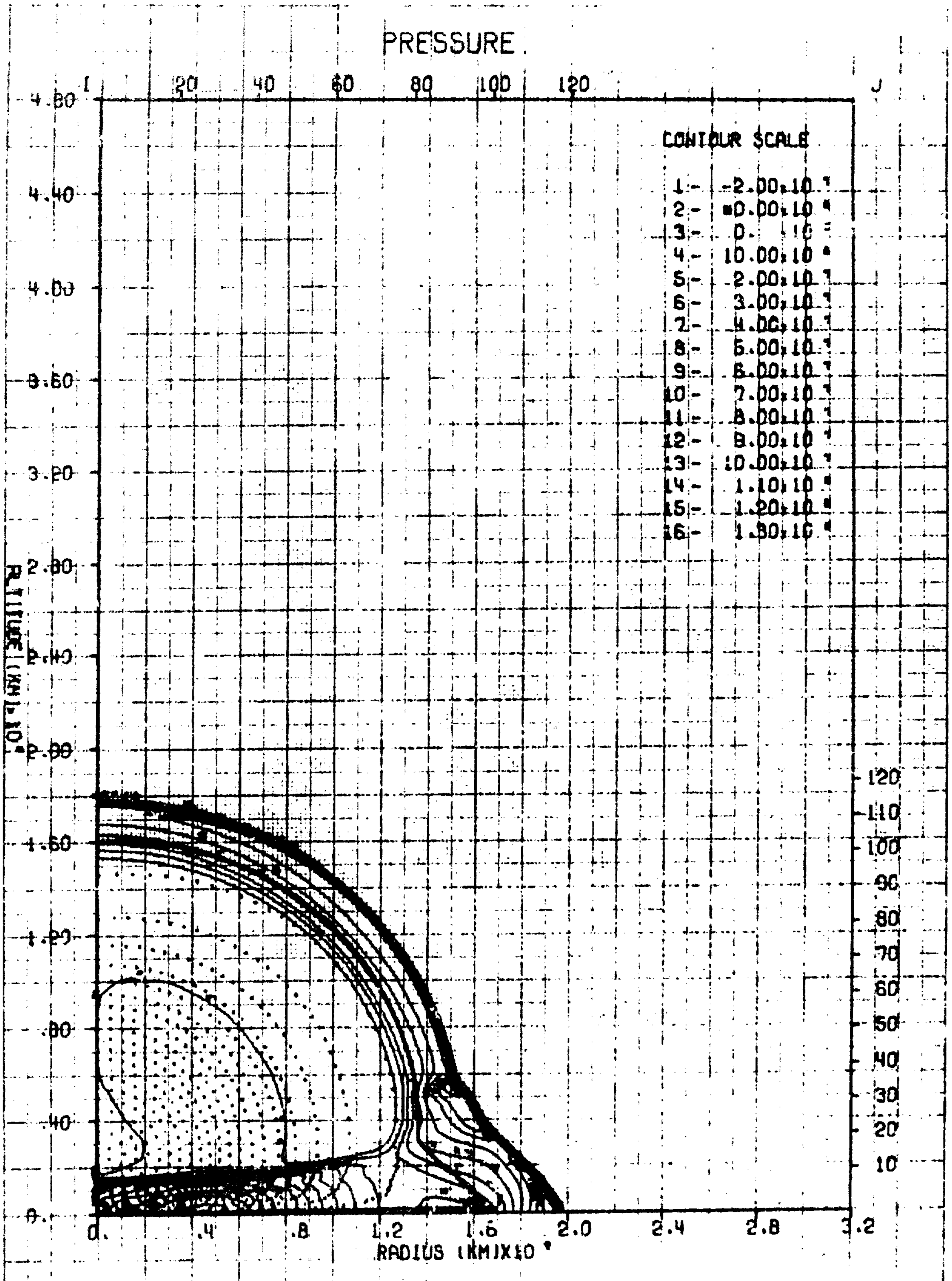

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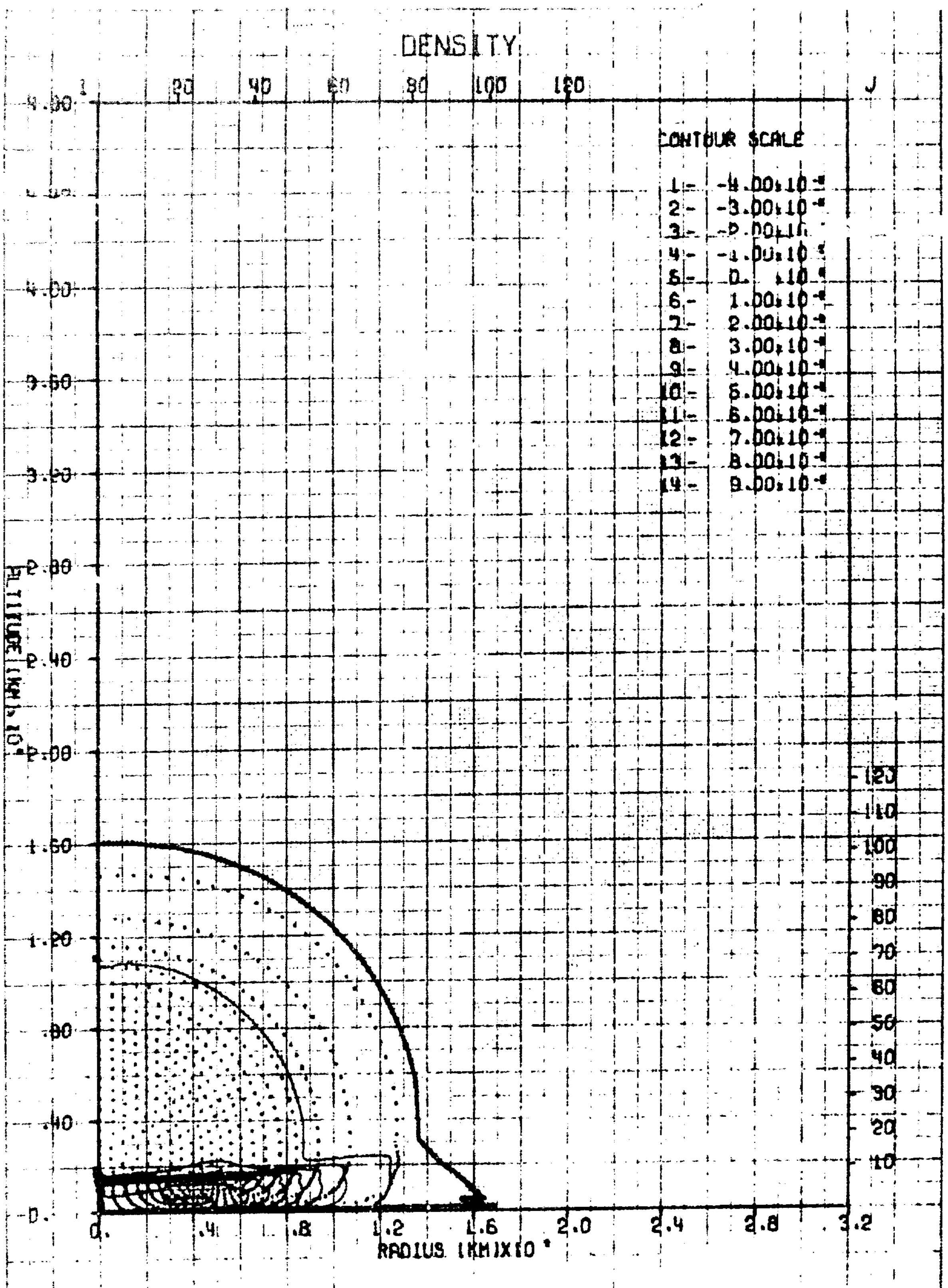

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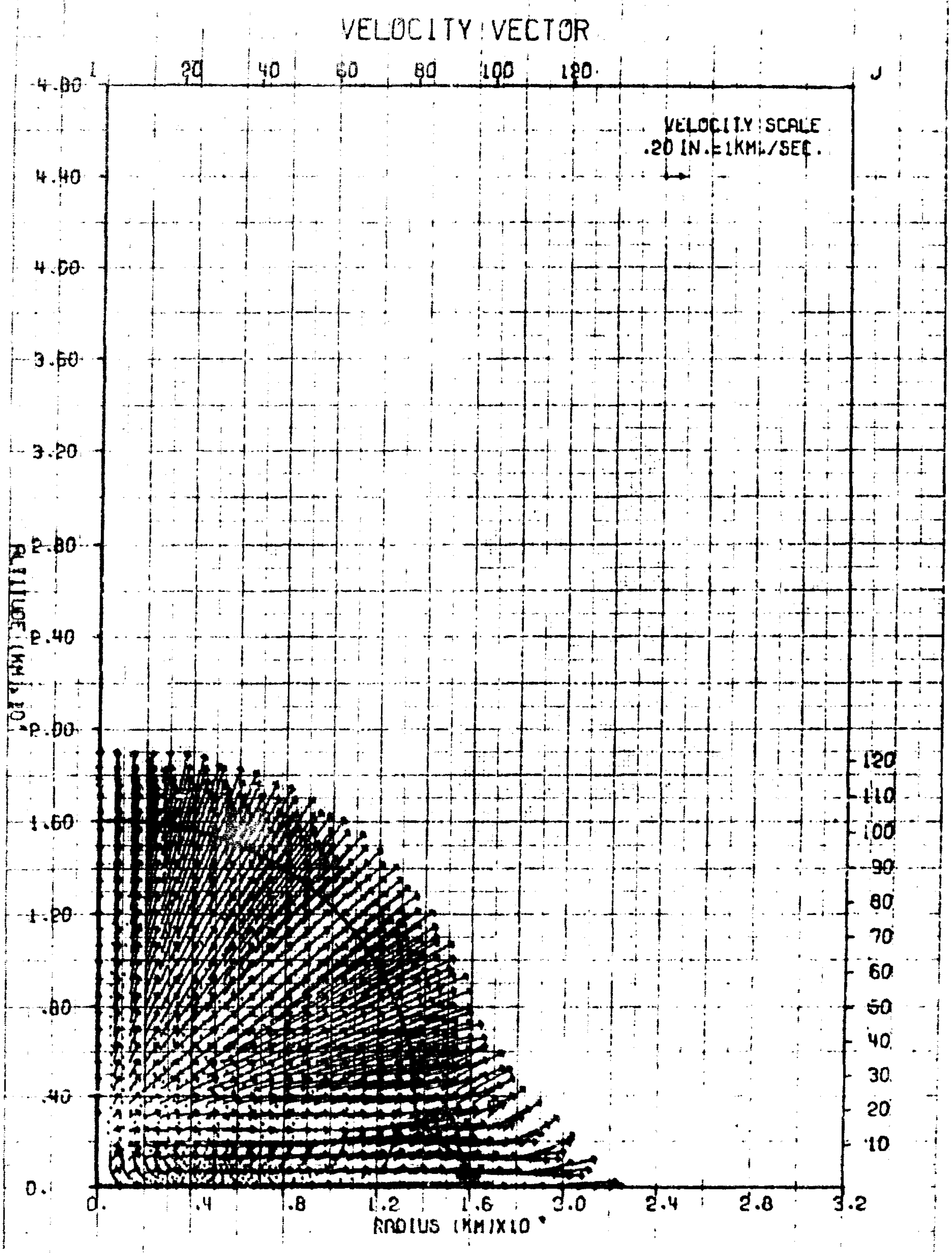

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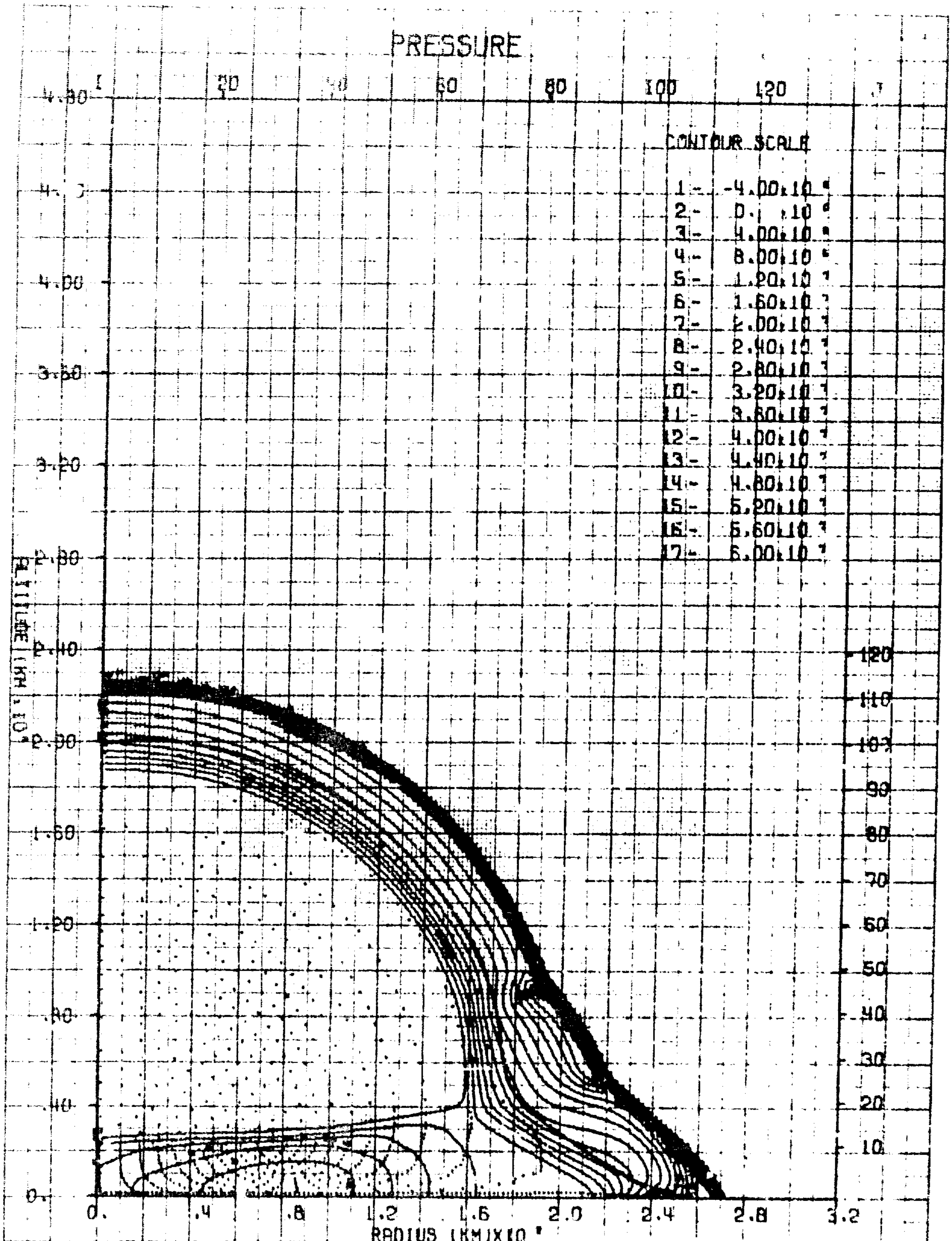

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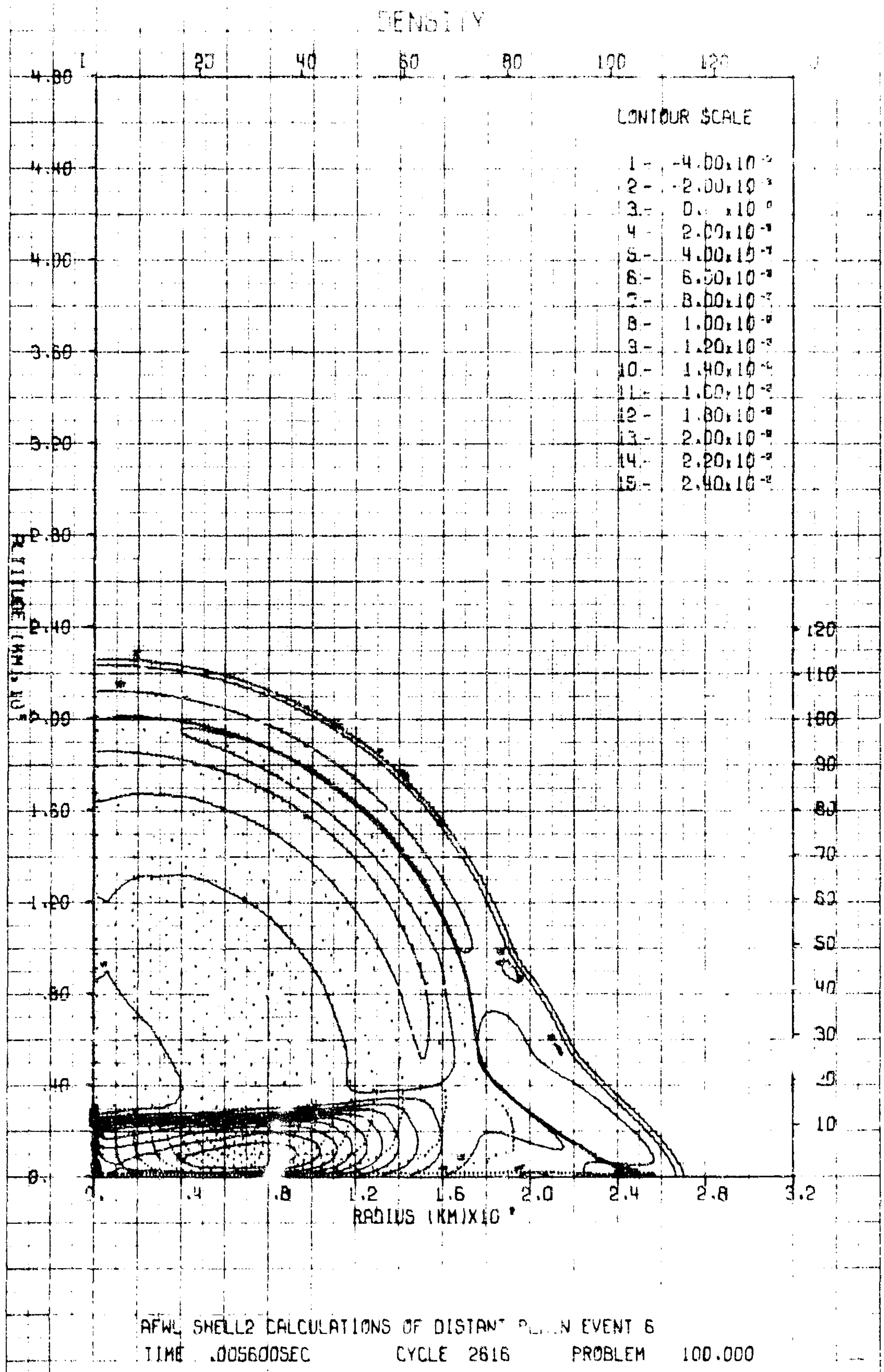

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3 - 0. x10
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5 - 4.00x10
6 - 6.00x10
8.00x10
8 - 1.00x10
9 - 1.20x10
10 - 1.40x10
1.60x10
12 - 1.80x10
13 - 2.00x10
14 - 2.20x10
15 - 2.40x10
RADIUS (KM)X10
ALTITUDE (KM)
4.80
4.40
4.00
3.60
3.20
2.80
2.40
2.00
1.60
1.20
.80
.40
0.
.4
.8
1.2
1.6
2.0
2.4
2.8
3.2
20
40
60
80
100
120
110
100
90
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70
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40
30
10
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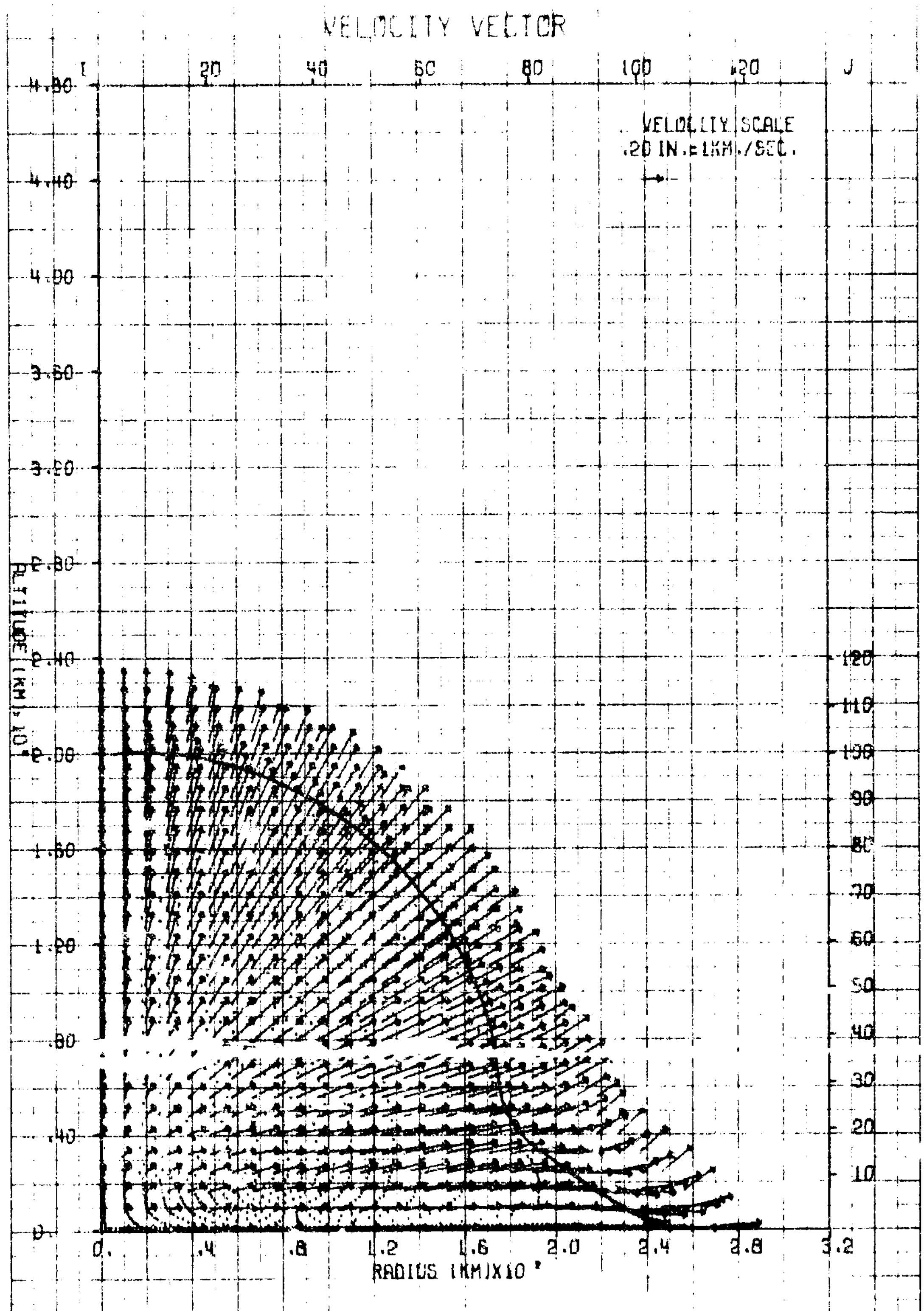
EVENT 6
TIME .0056000SEC
CYCLE 2616
PROBLEM 100.000



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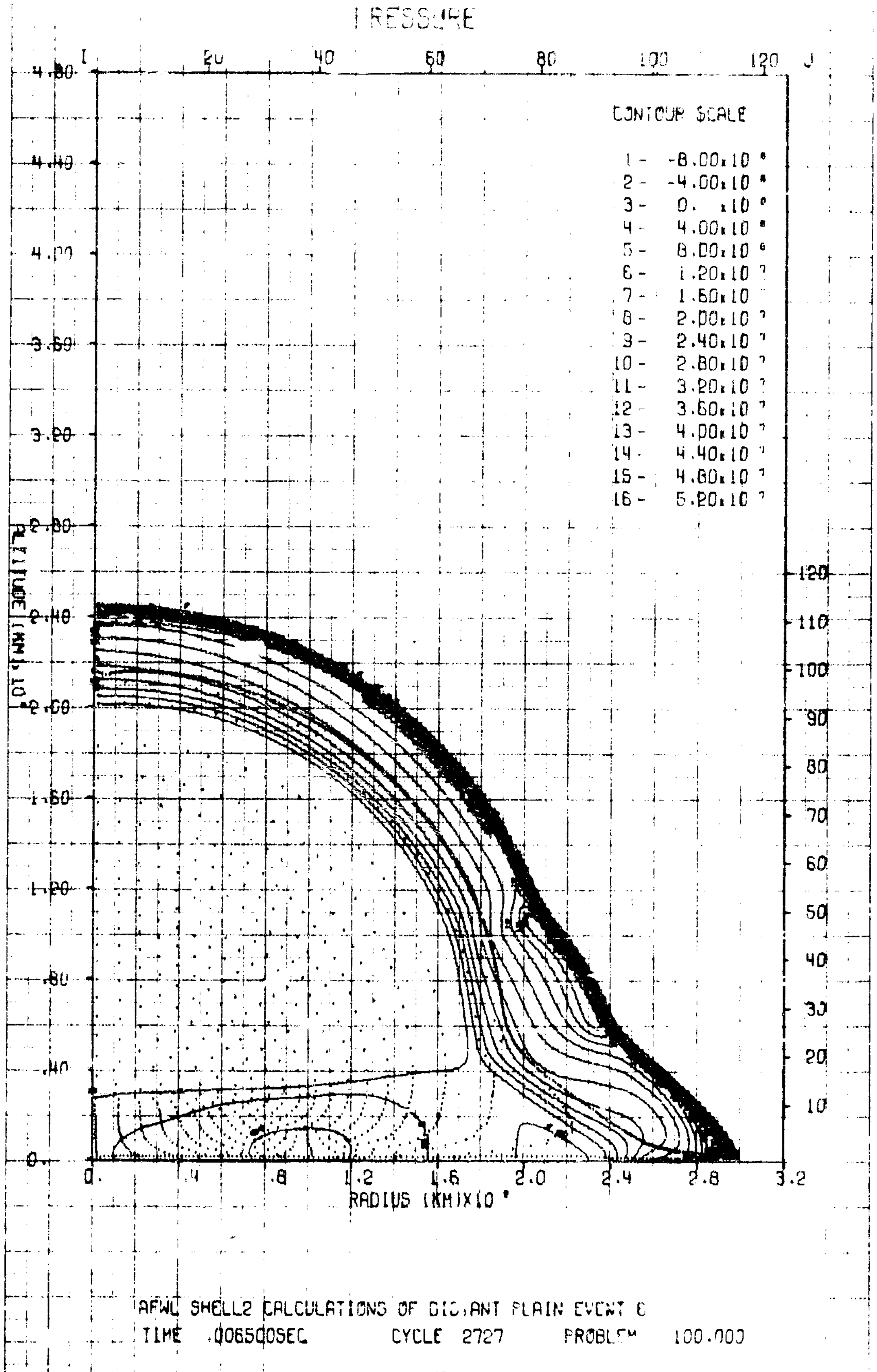
PRESSURE
CONTOUR SCALE
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5 - 8.00x10 6
6 - 1.20x10 7
7 - 1.60x10 7
8 - 2.00x10 7
9 - 2.40x10 7
10 - 2.80x10 7
11 - 3.20x10 7
12 - 3.60x10 7
13 - 4.00x10 7
14 - 4.40x10 7
15 - 4.80x10 7
16 - 5.20x10 7
ALTITUDE (KM)x10 0
RADIUS (KM)x10 0
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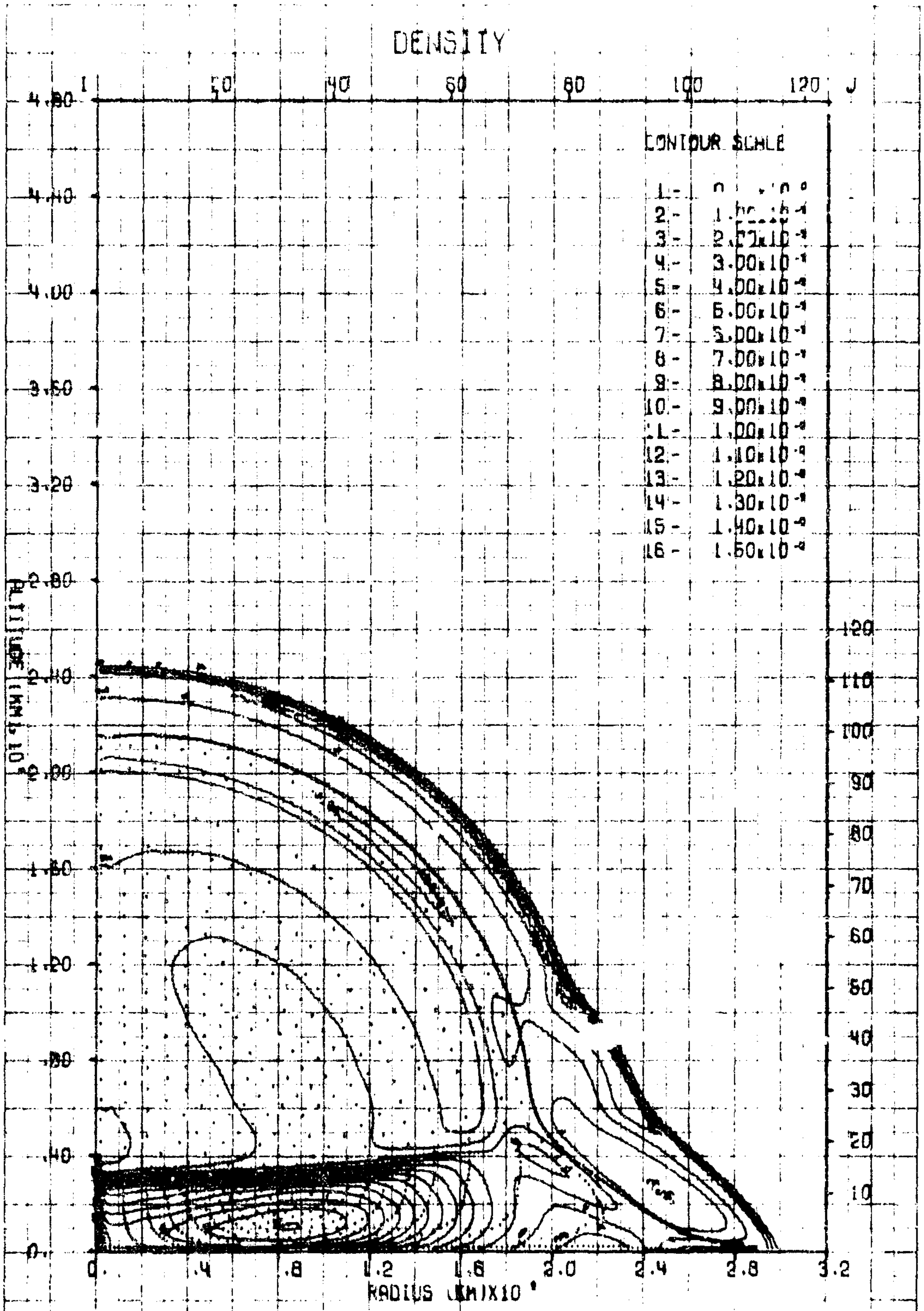

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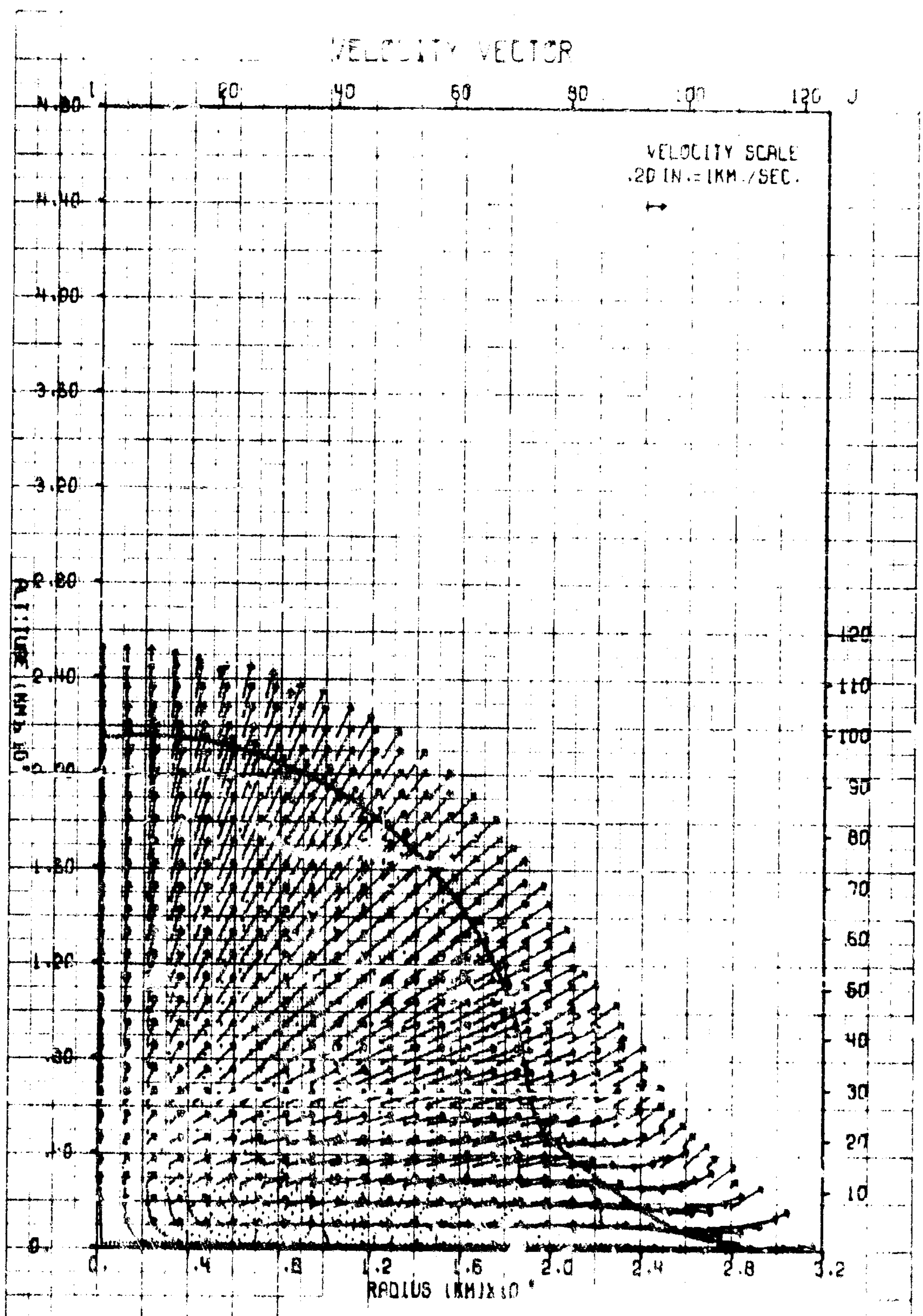

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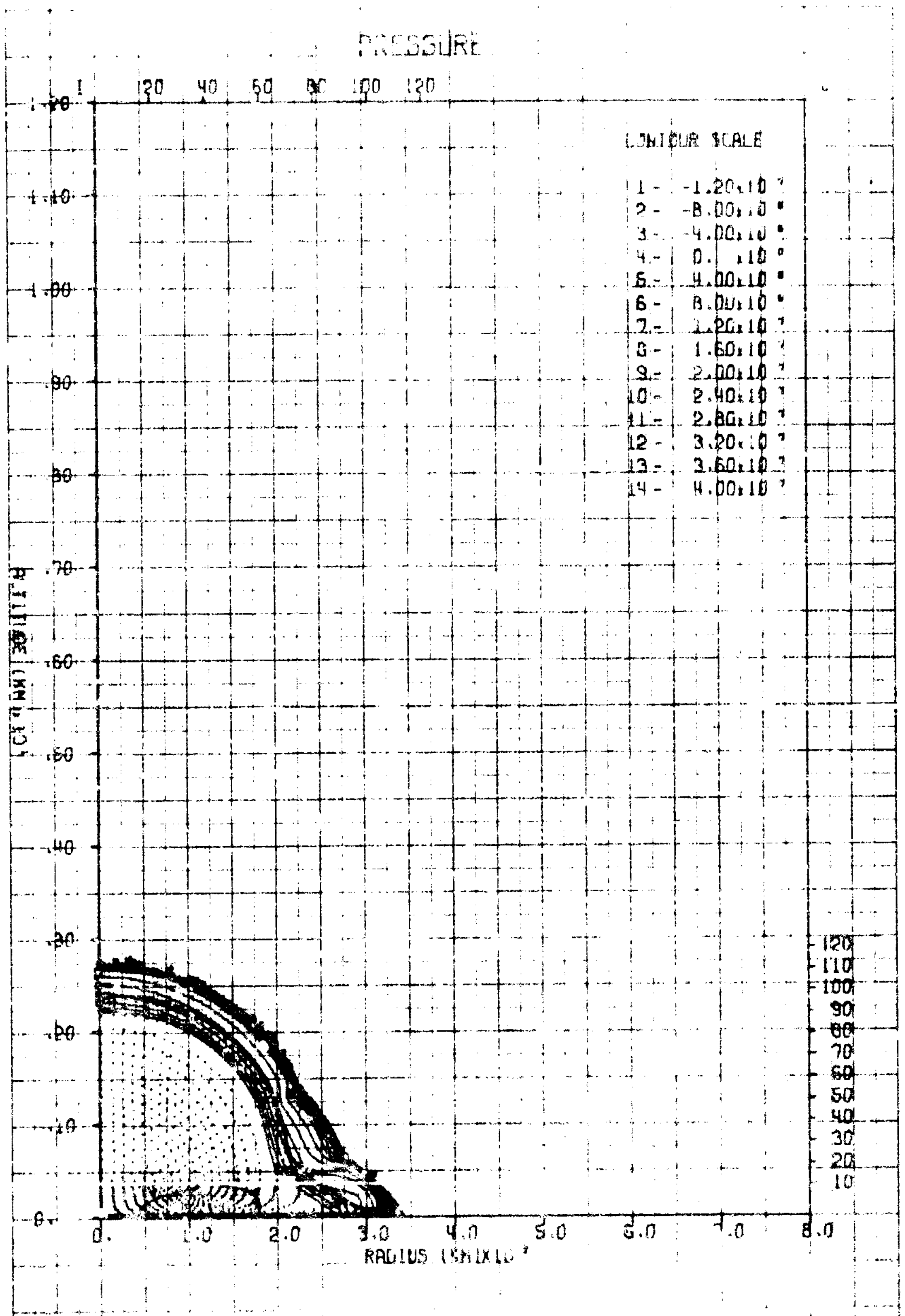
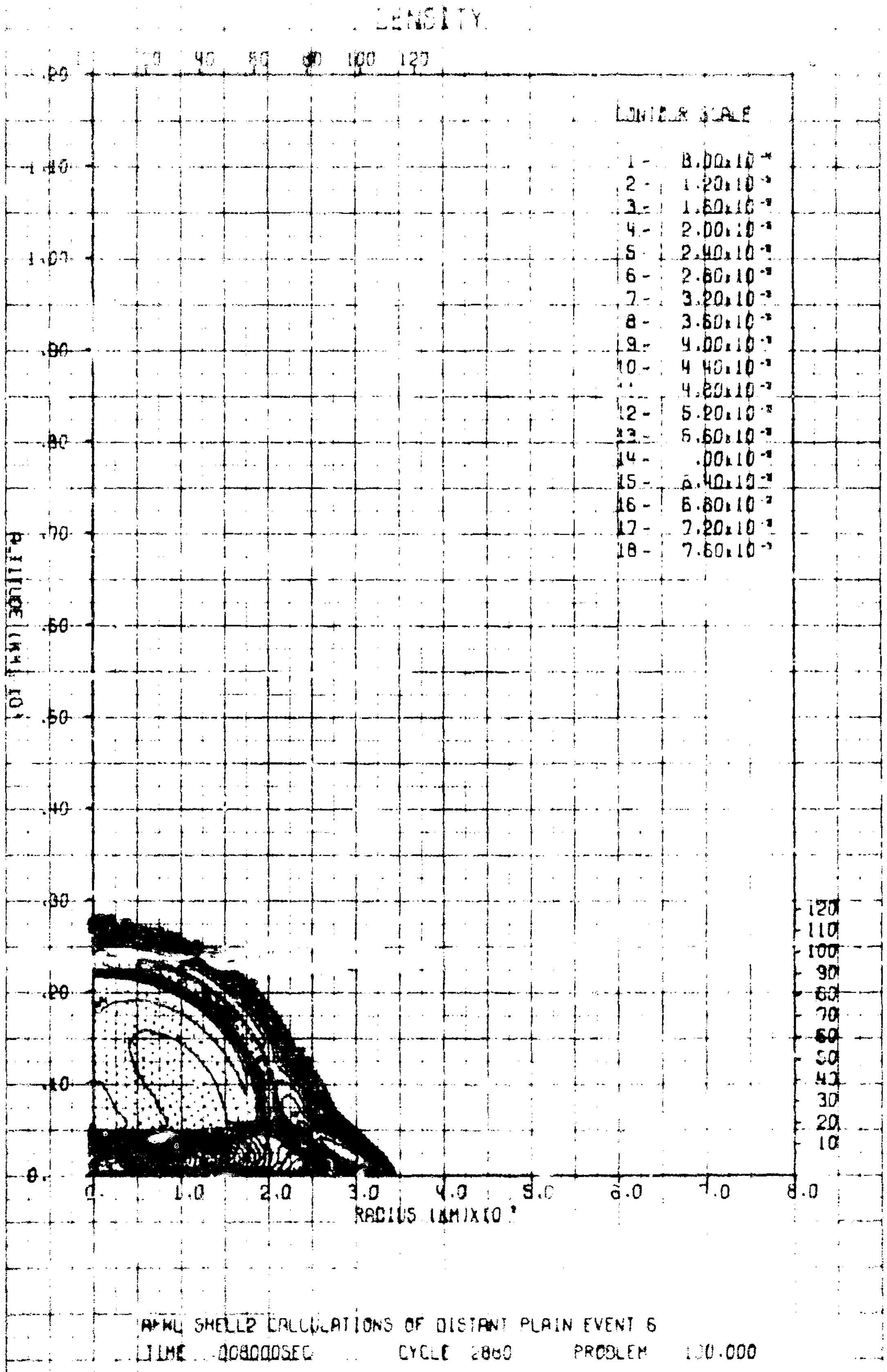


HANL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT
TIME .00800SEC CYCLE 2880 PROBLEM 100.000


DENSITY
CONTOUR SCALE
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3 - 1.60x10
4 - 2.00x10
5 - 2.40x10
6 - 2.80x10
7 - 3.20x10
8 - 3.60x10
9 - 4.00x10
10 - 4.40x10
4.80x10
12 - 5.20x10
13 - 5.60x10
14 - .00x10
15 - 6.40x10
16 - 6.80x10
17 - 7.20x10
18 - 7.60x10
RADIUS (KM)X10
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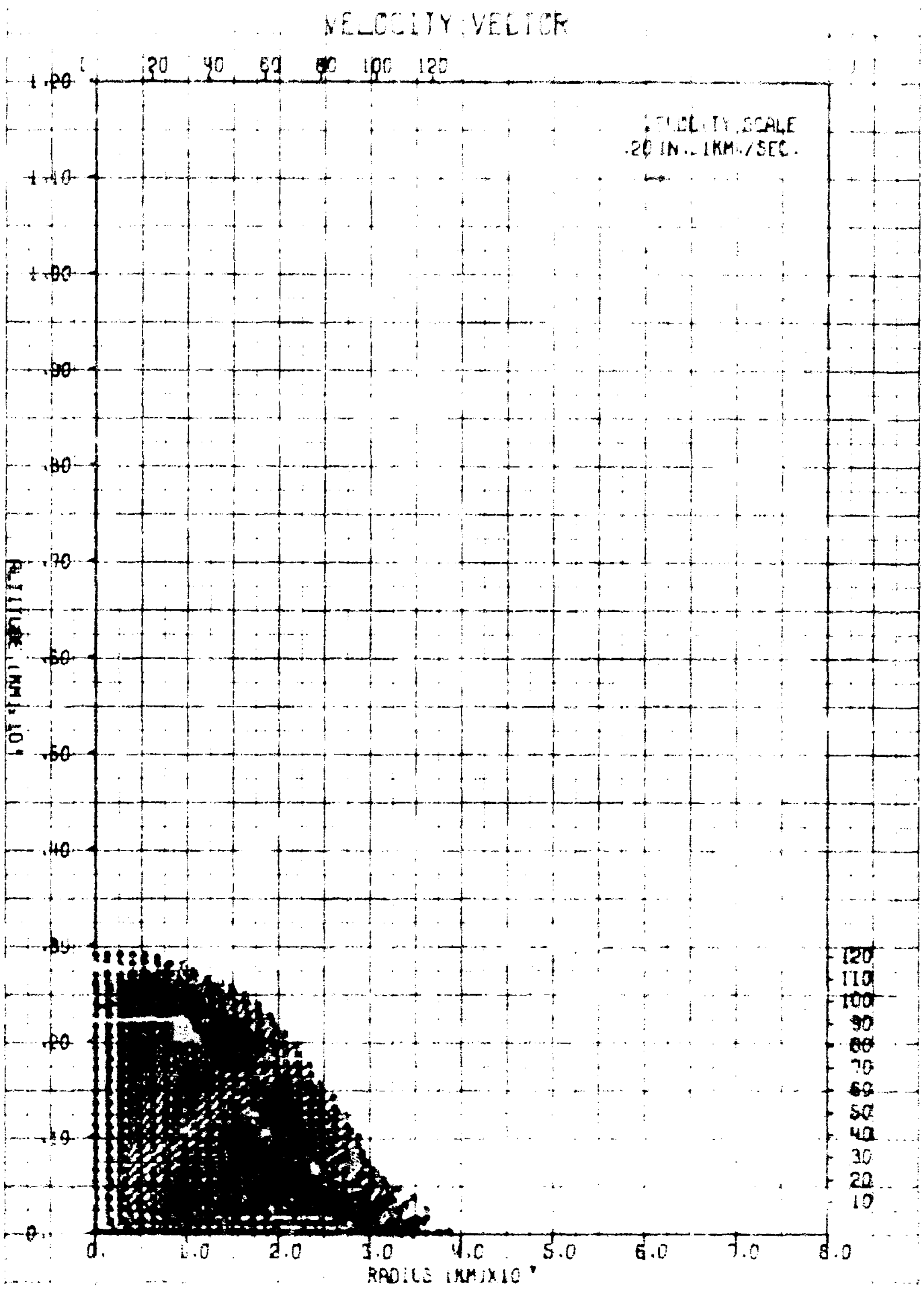
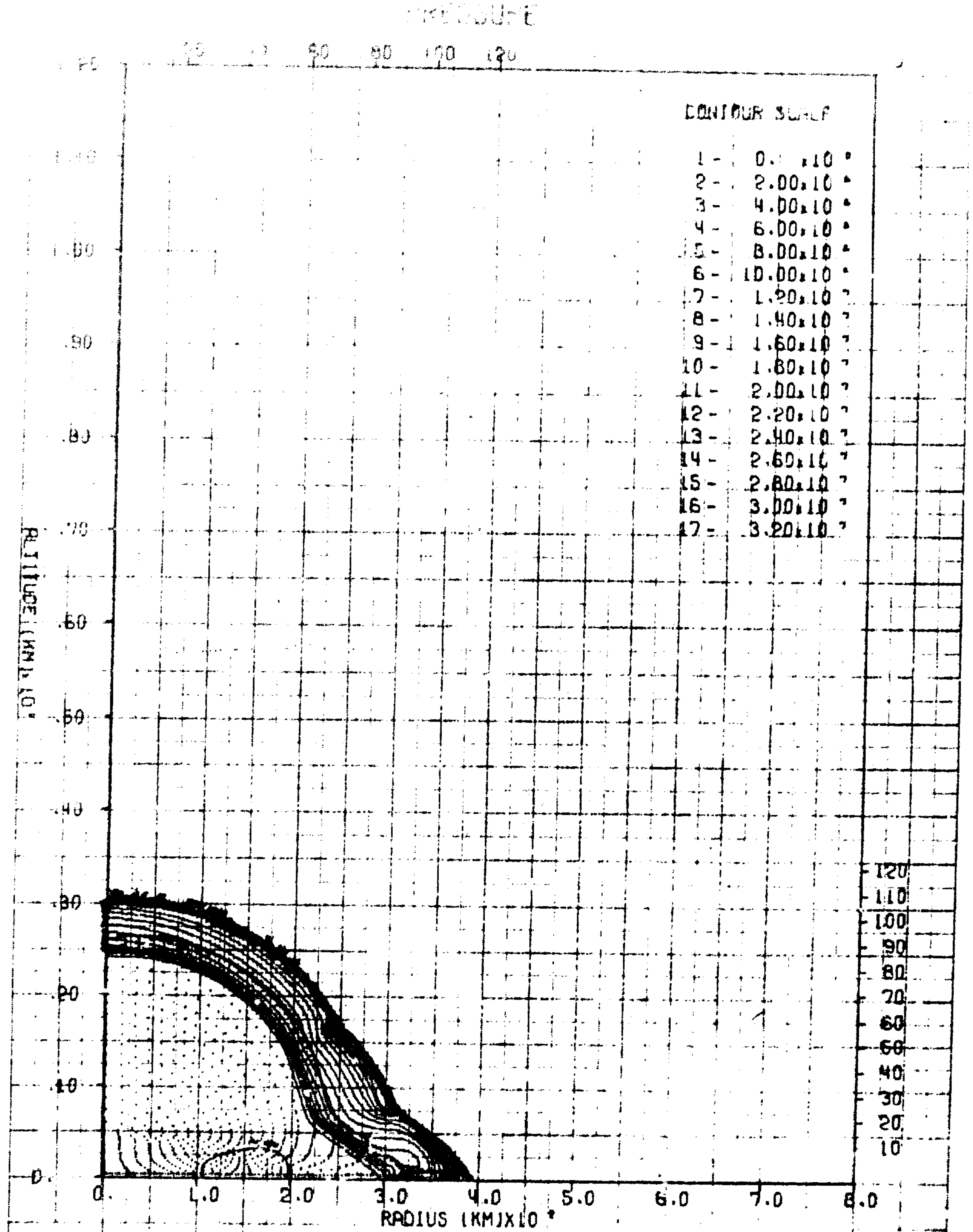
TIME .008000SEC CYCLE 2860 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .03800OSEC CYCLE 2380 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
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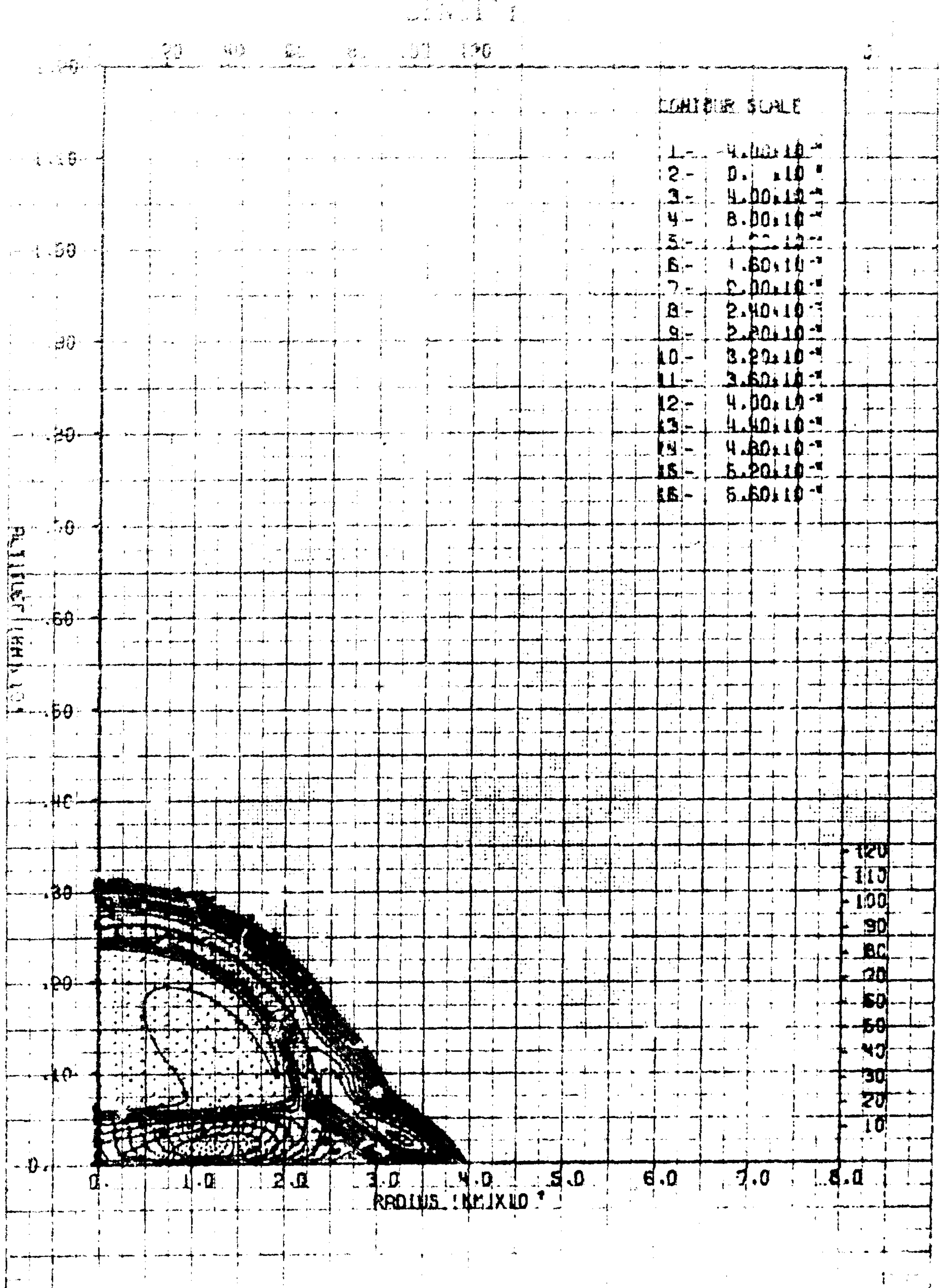

AFWL SHEL 2 CALCULATIONS OF DISTANT PLAIN EVENT 3
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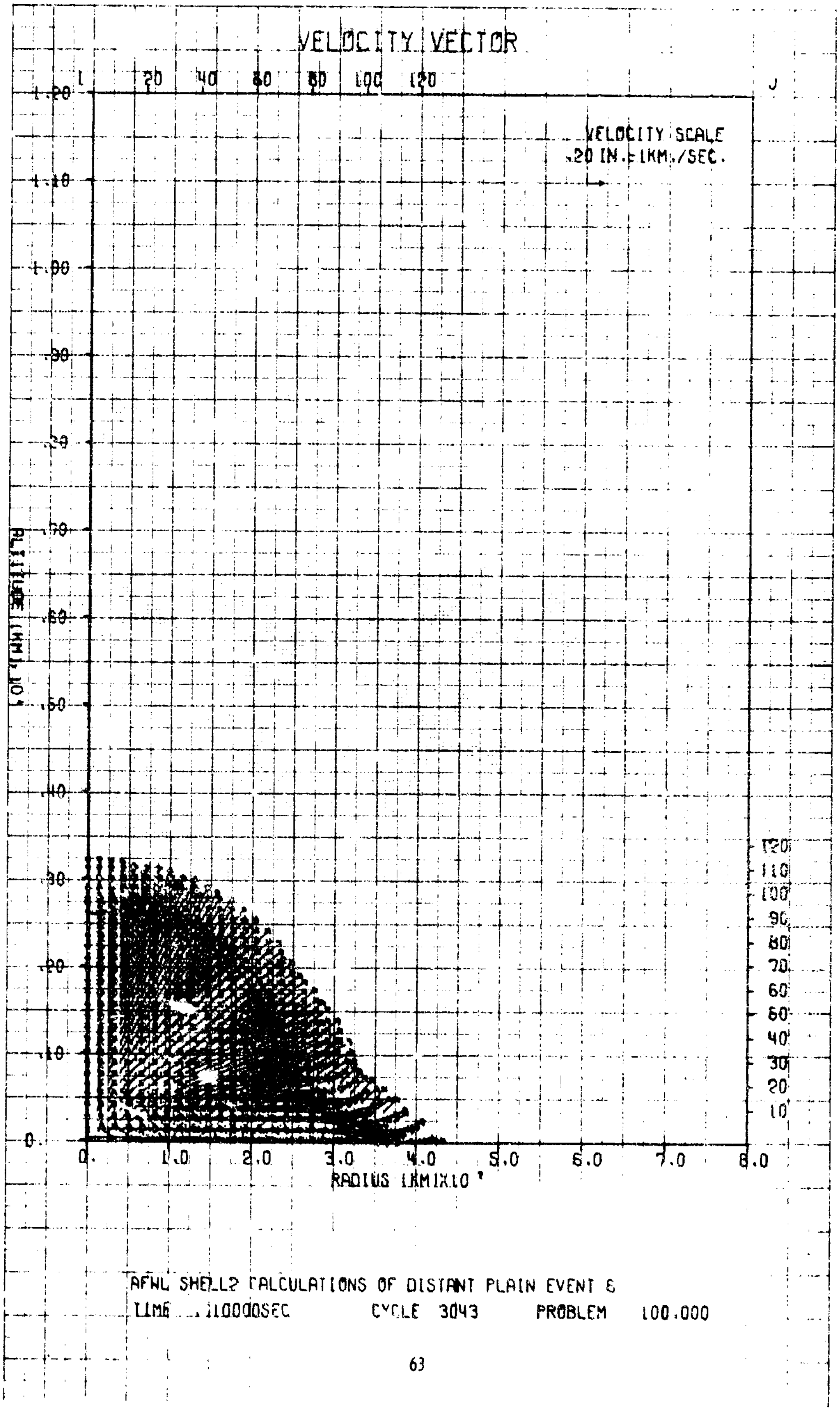
VELOCITY VECTOR
VELOCITY SCALE
.20 IN.=1KM./SEC.
RADIUS (KM)X10
ALTITUDE (KM)X10
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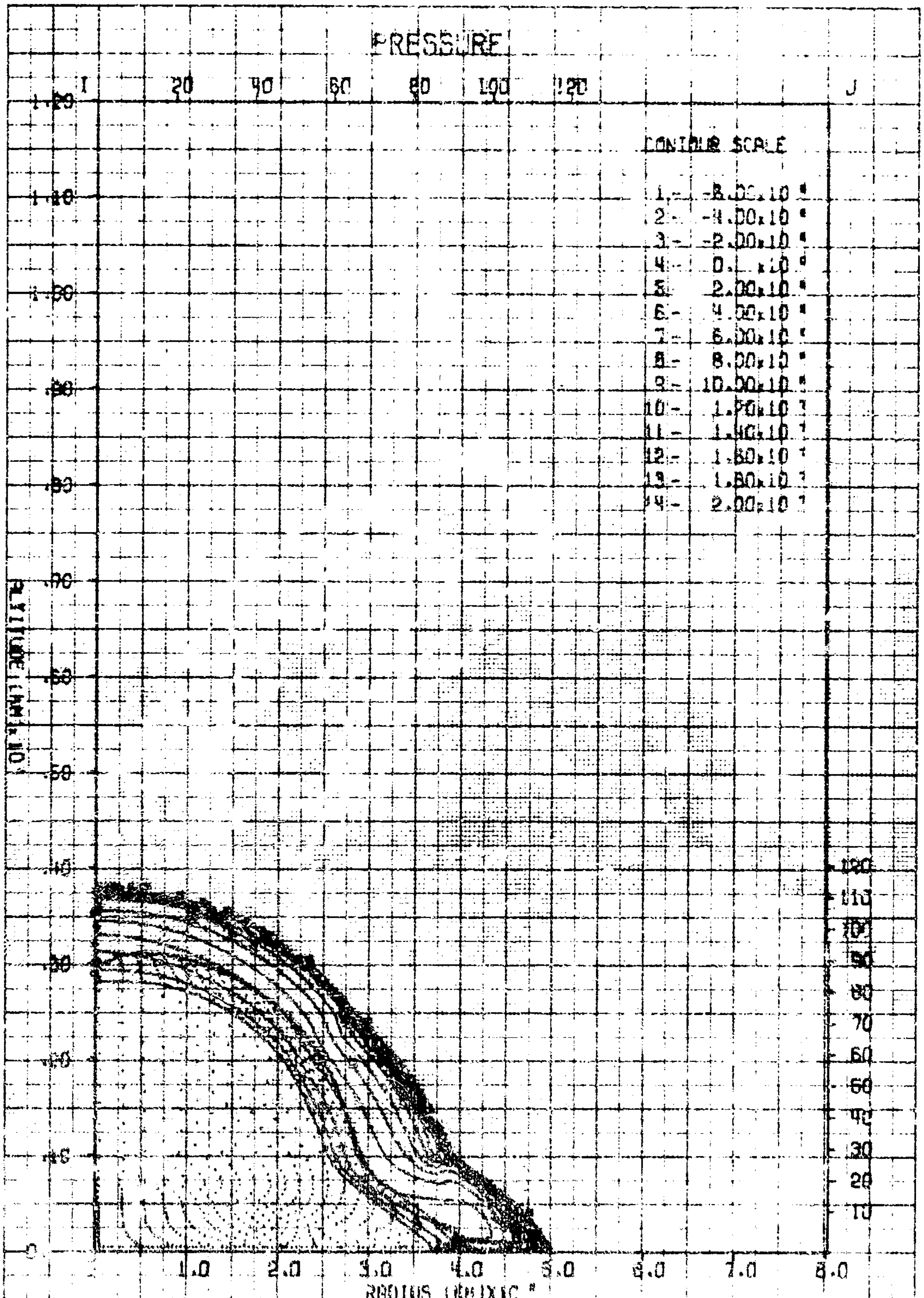
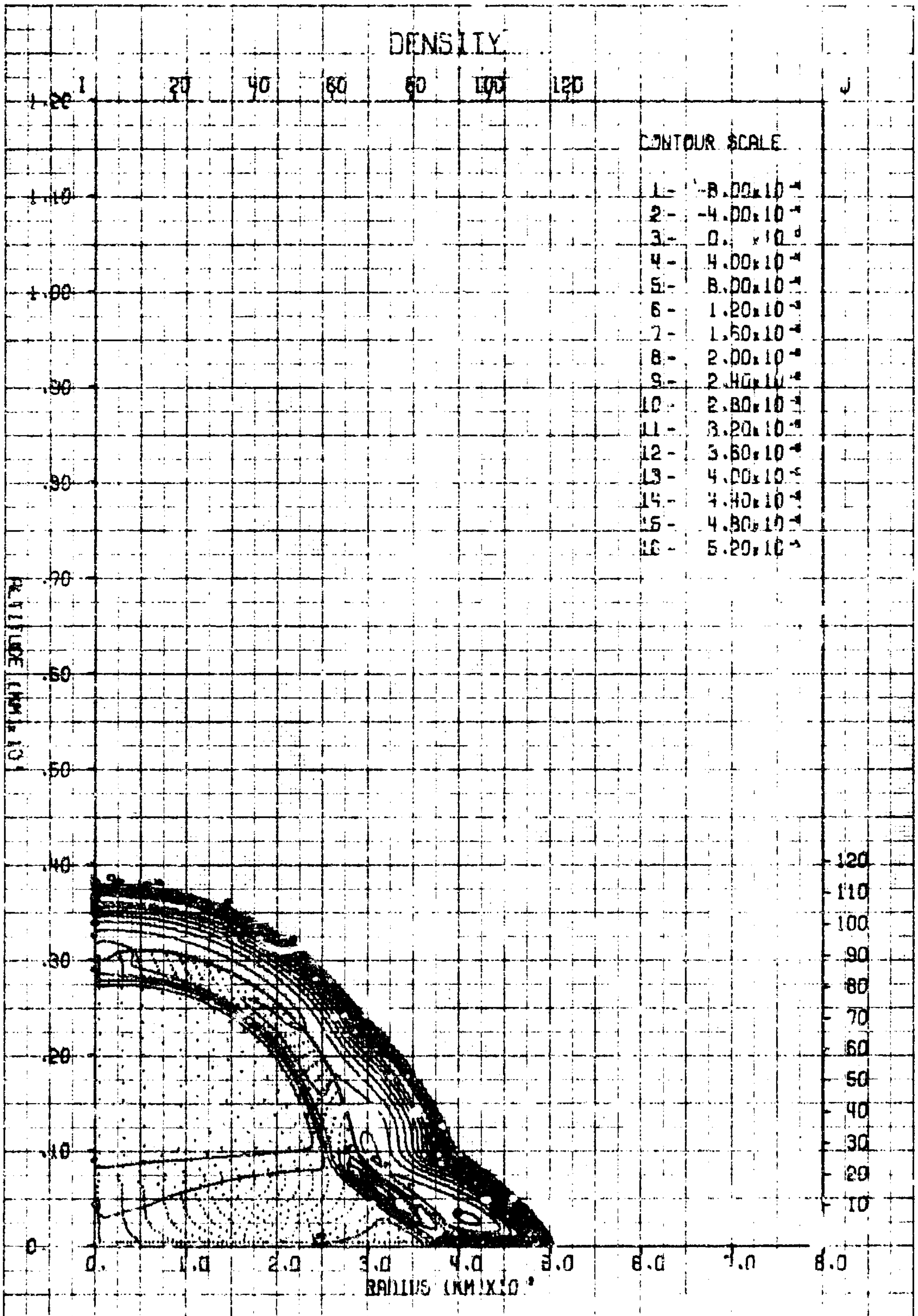


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

TIME .018 SEC CYCLE 3332 PROBLEM 100.000



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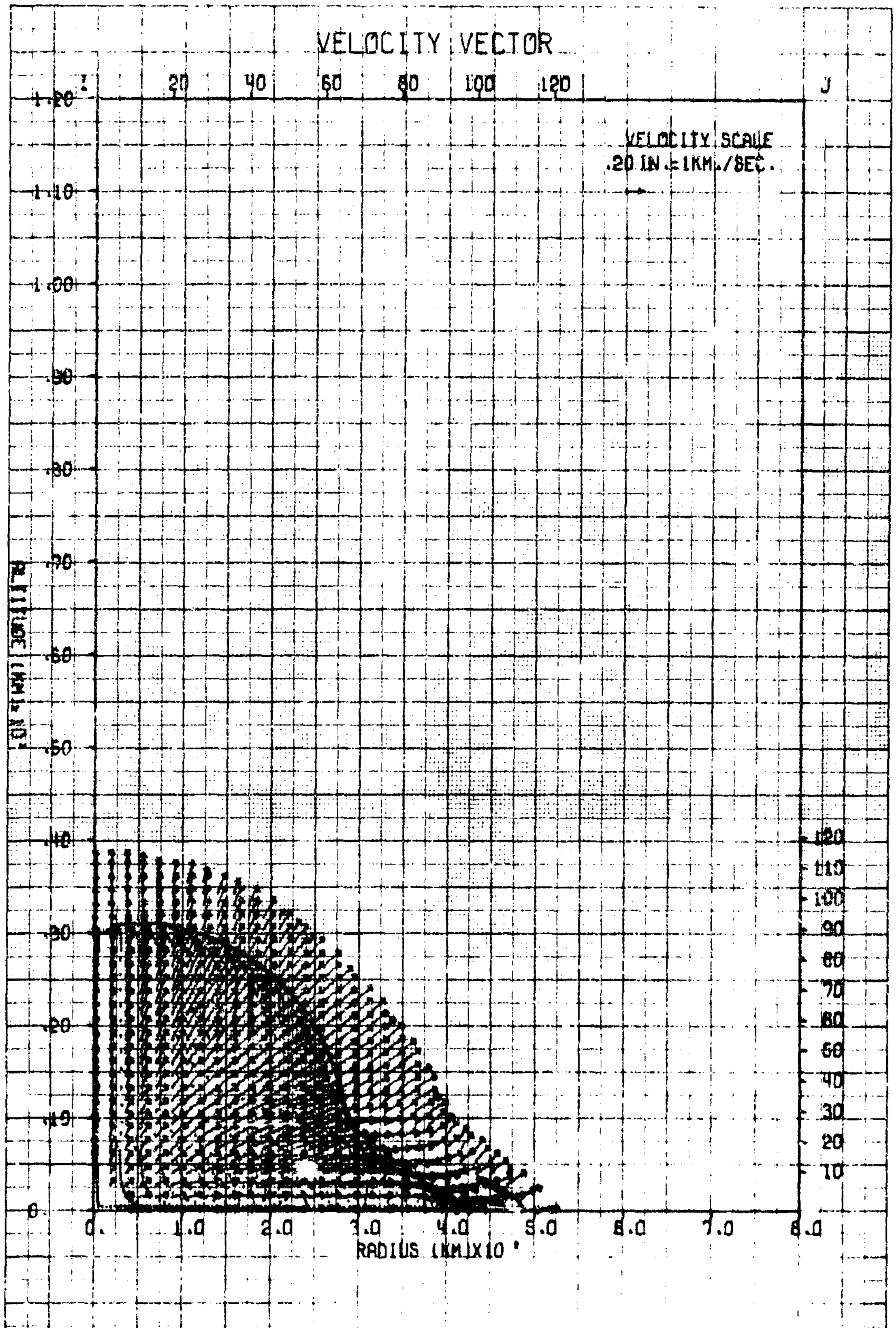

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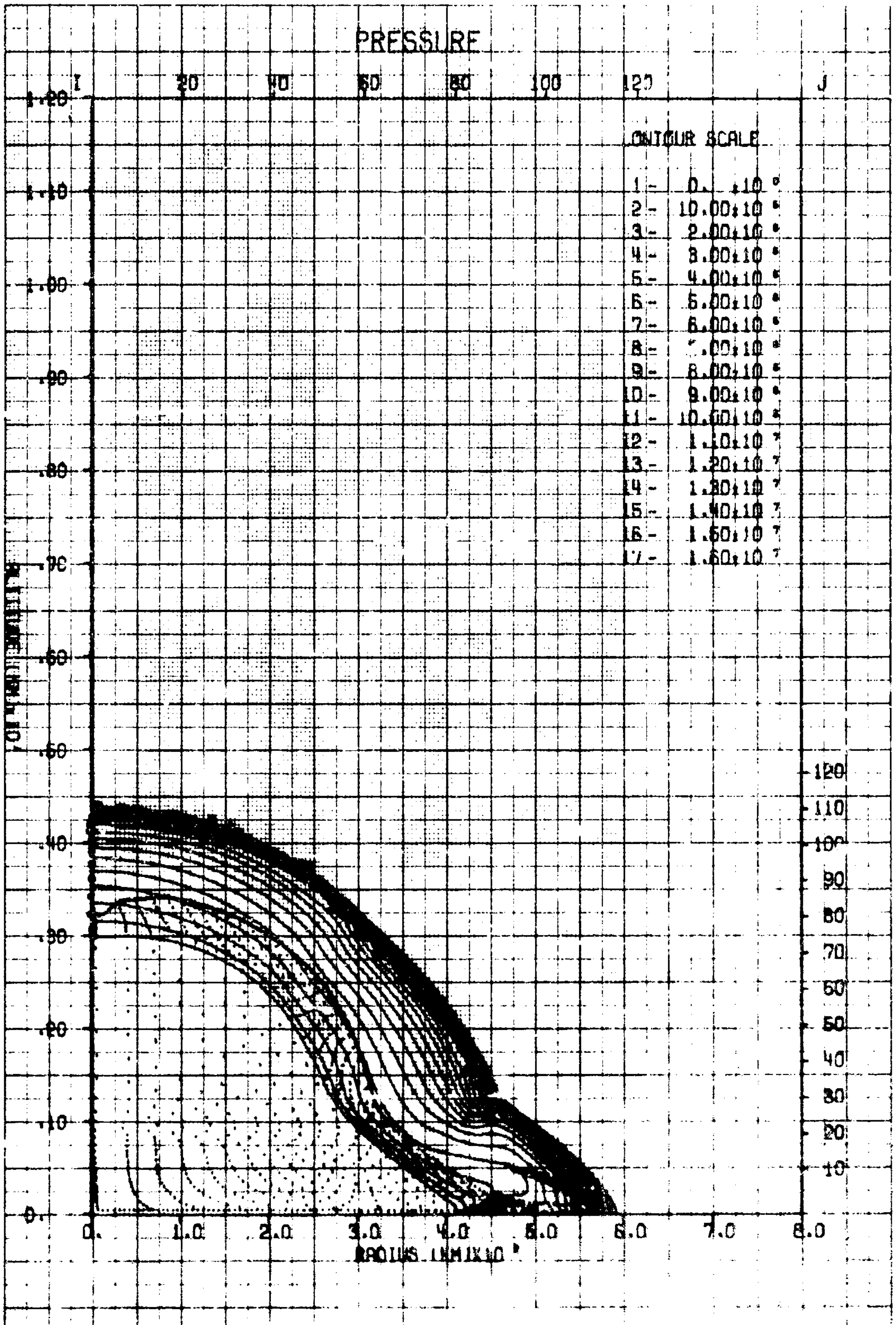
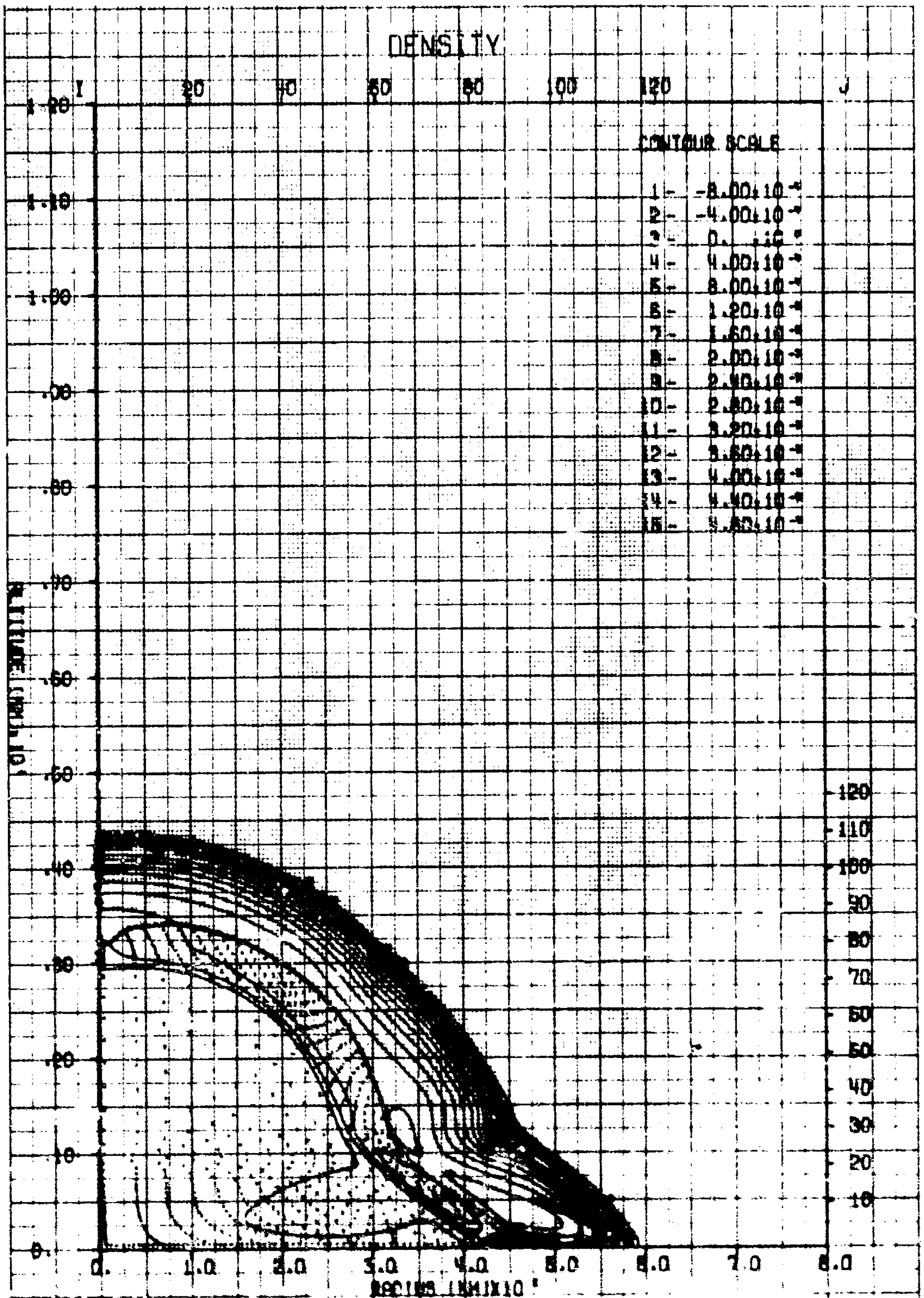
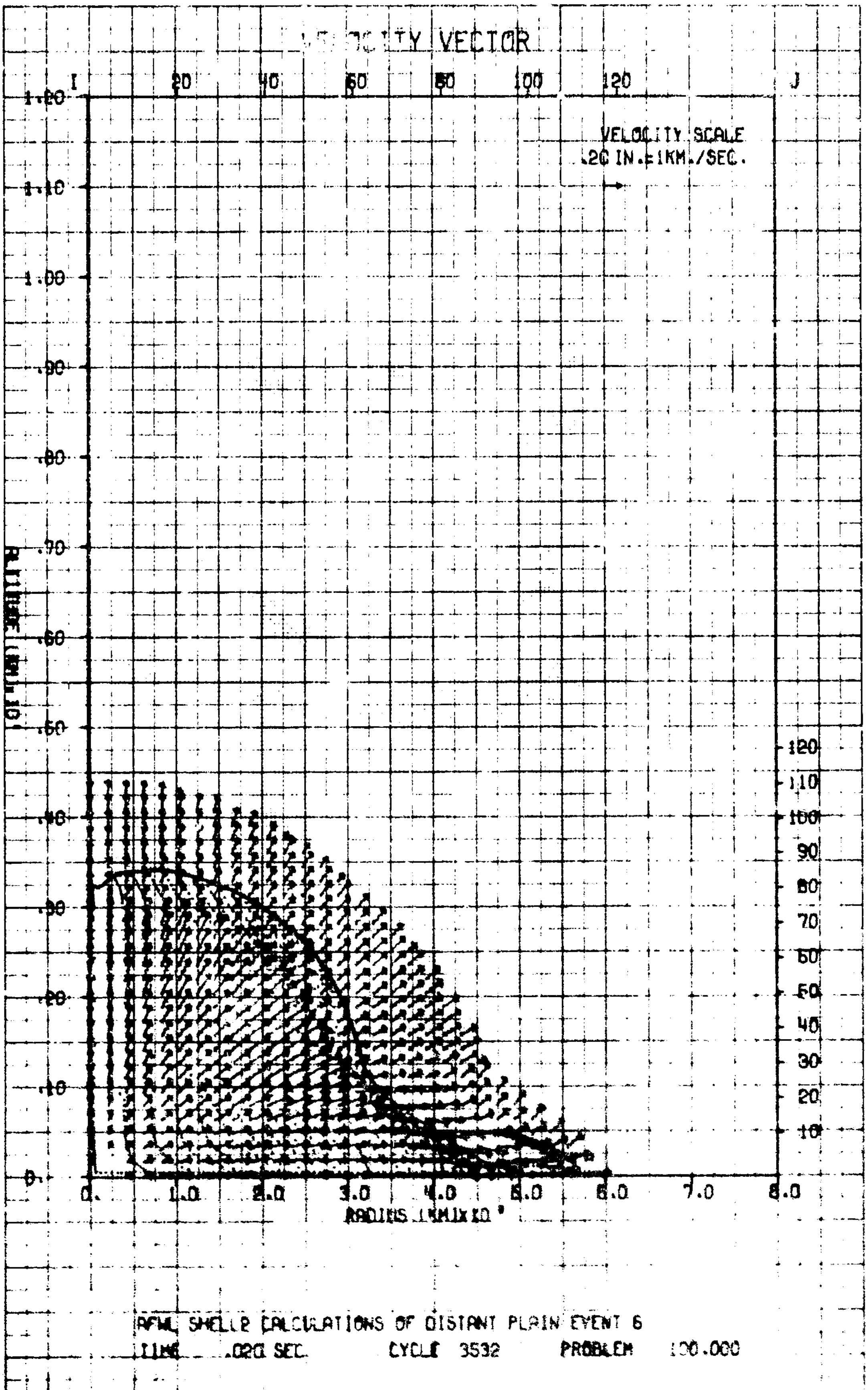
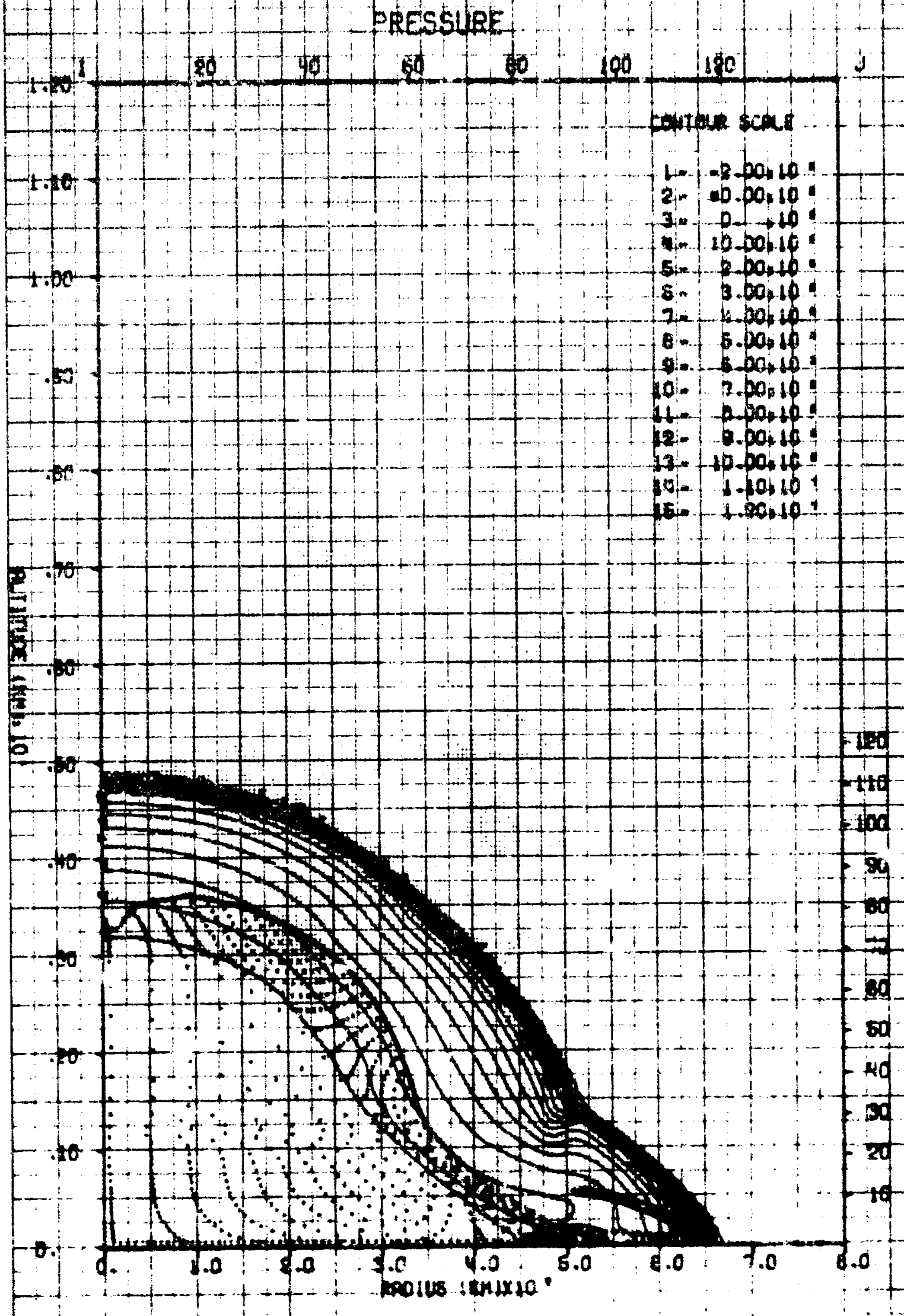


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .020 SEC. CYCLE 3532 PROBLEM 100.000

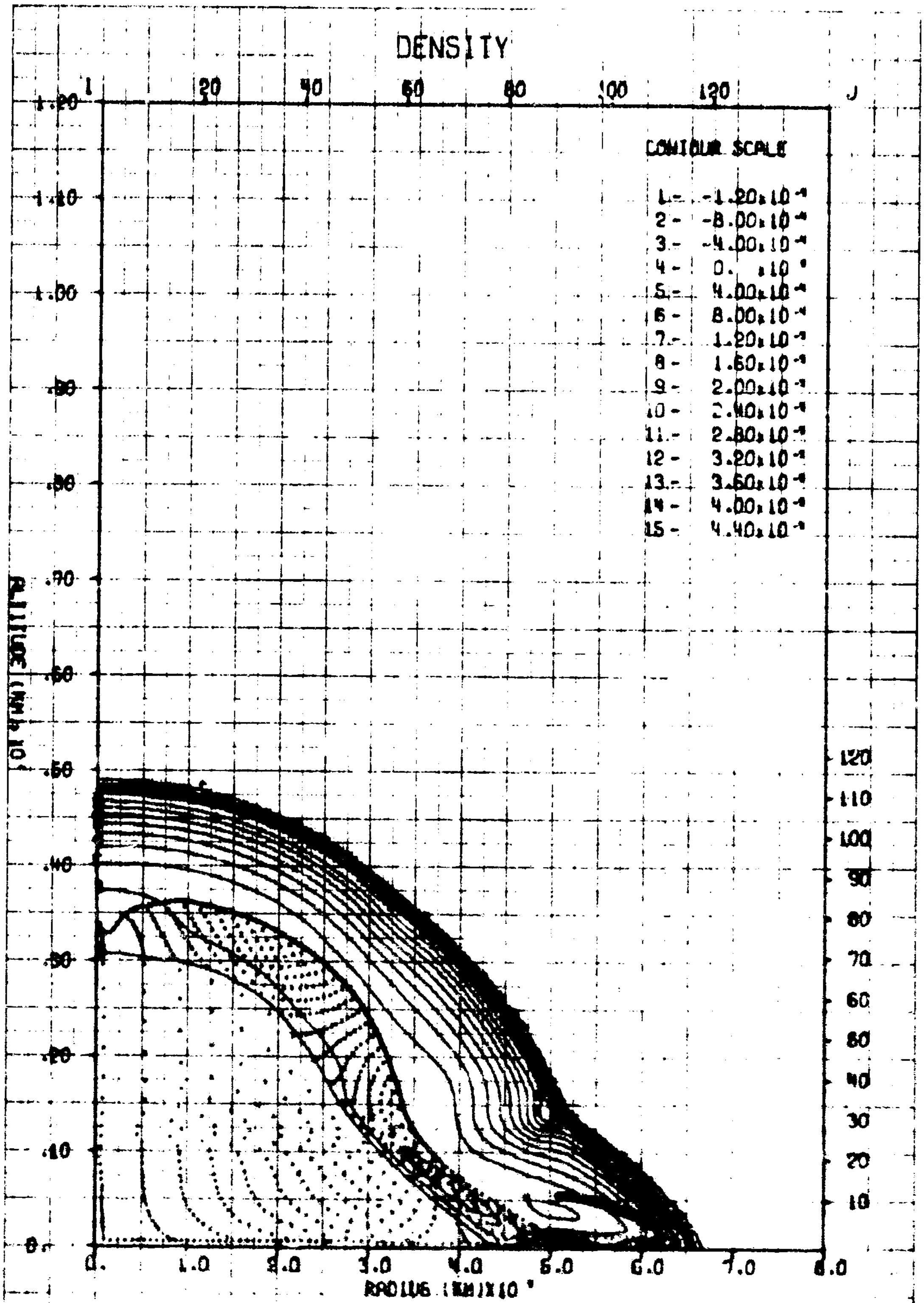


AFWL SHELLP CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .020 SEC. CYCLE 3532 PROBLEM 100.000

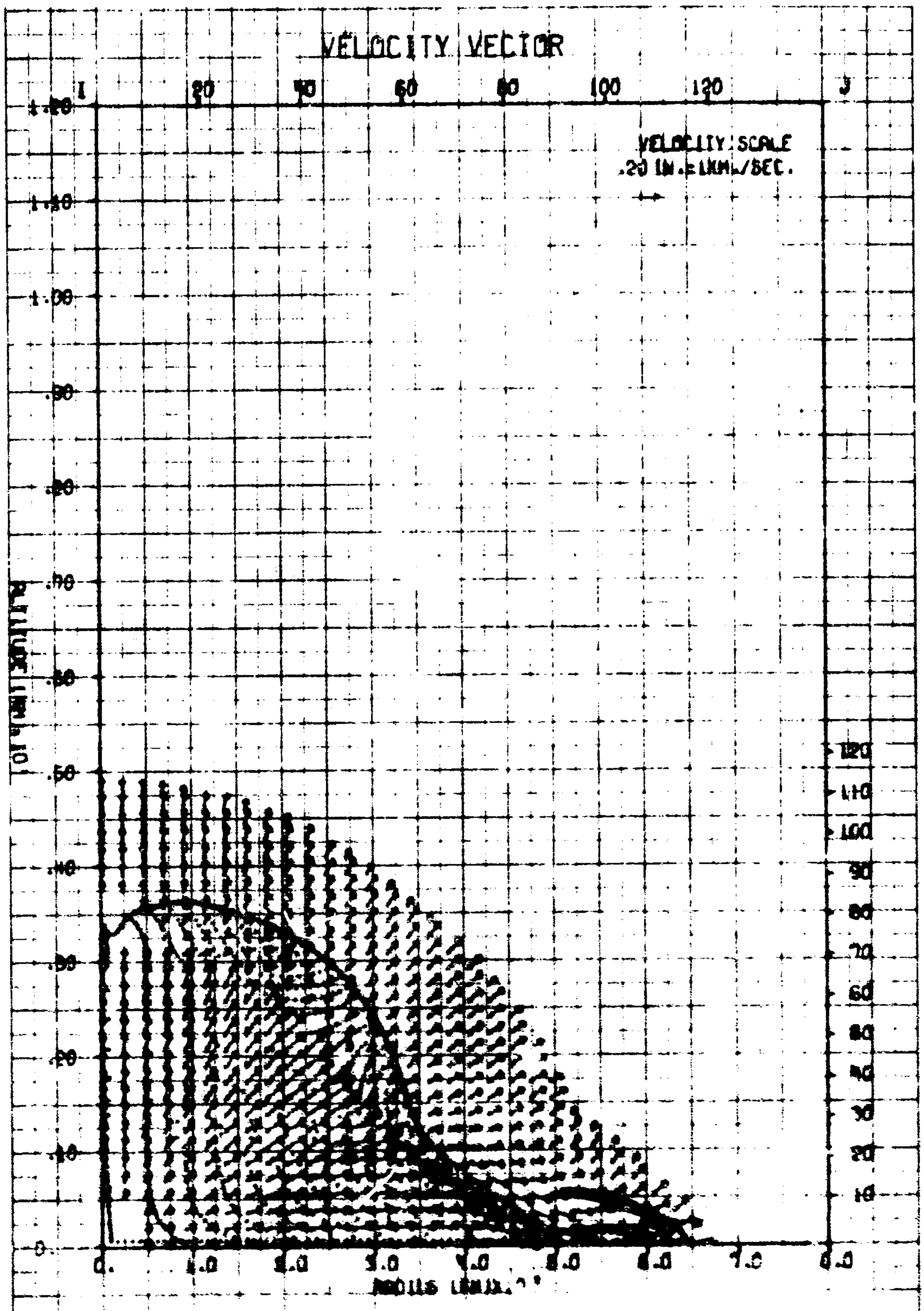

VELOCITY VECTOR
I
20
40
60
80
100
120
J
VELOCITY SCALE
.20 IN.=1KM./SEC.
1.20
1.10
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
0
ALTITUDE (KM)x10
120
110
100
90
80
70
60
50
40
30
20
10
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
RADIUS (KM)x10
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .020 SEC. CYCLE 3532 PROBLEM 100.000



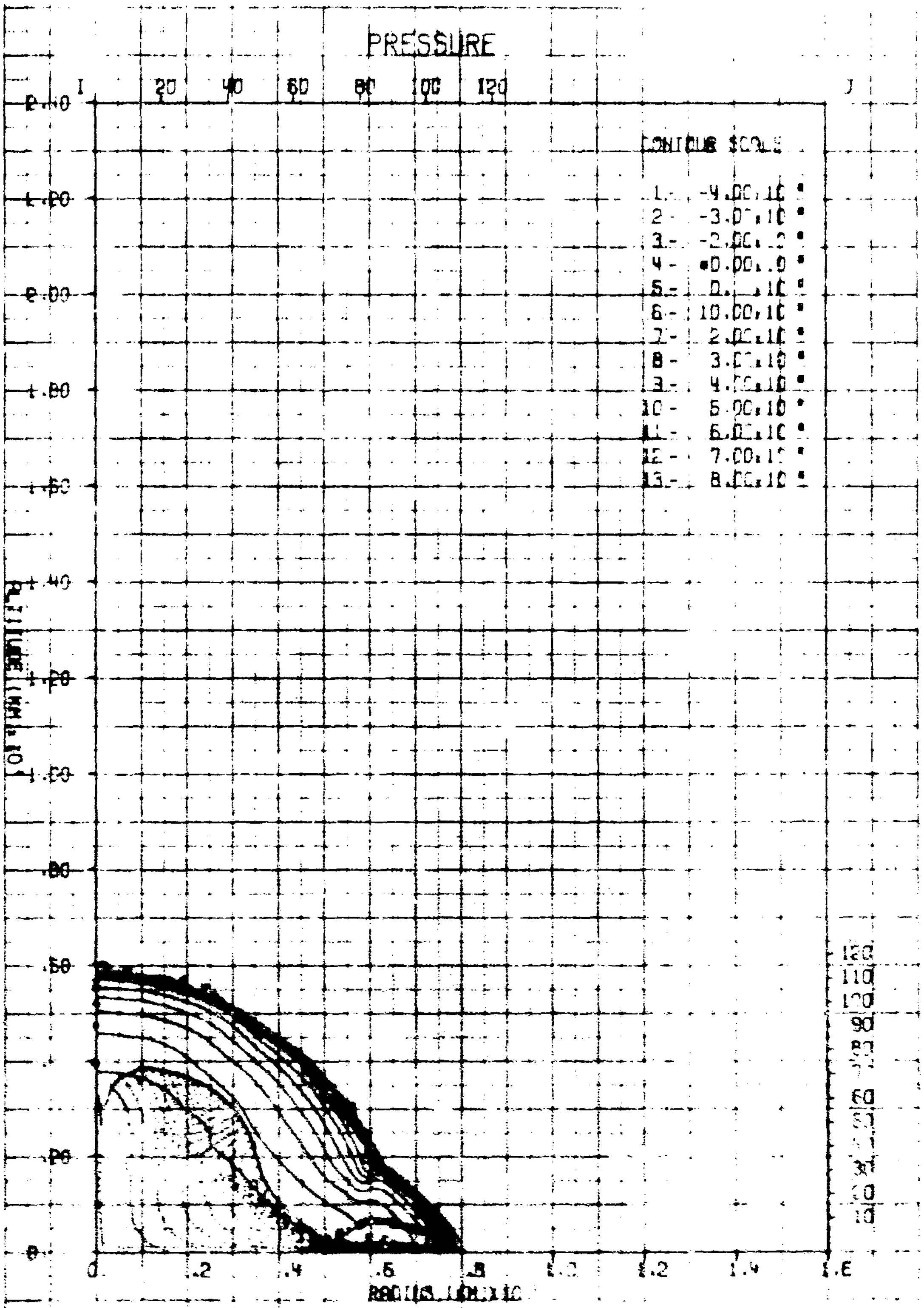
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .025 SEC CYCLE 3684 PROBLEM 100.000



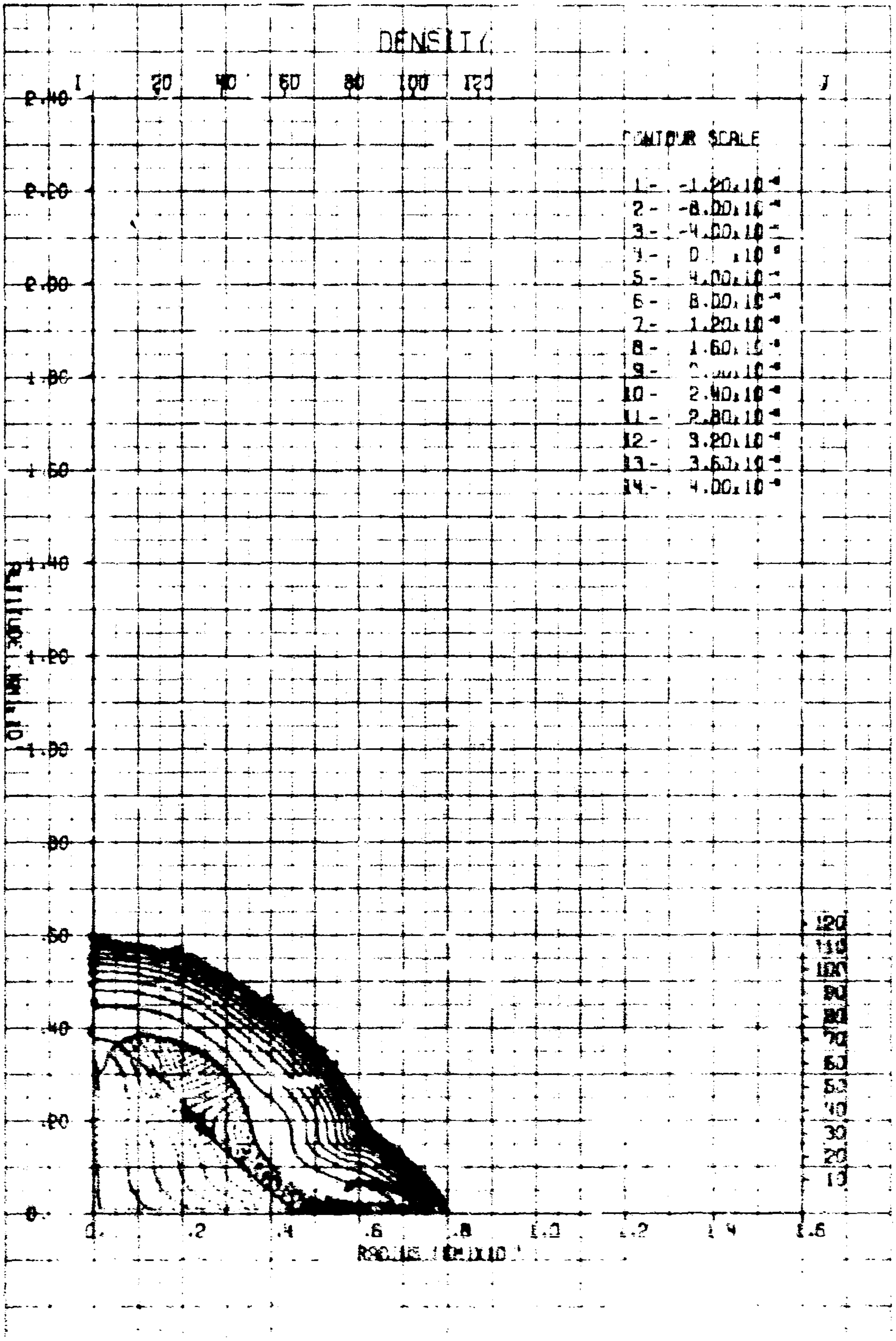
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .026 SEC CYCLE 3684 PROBLEM 100.000



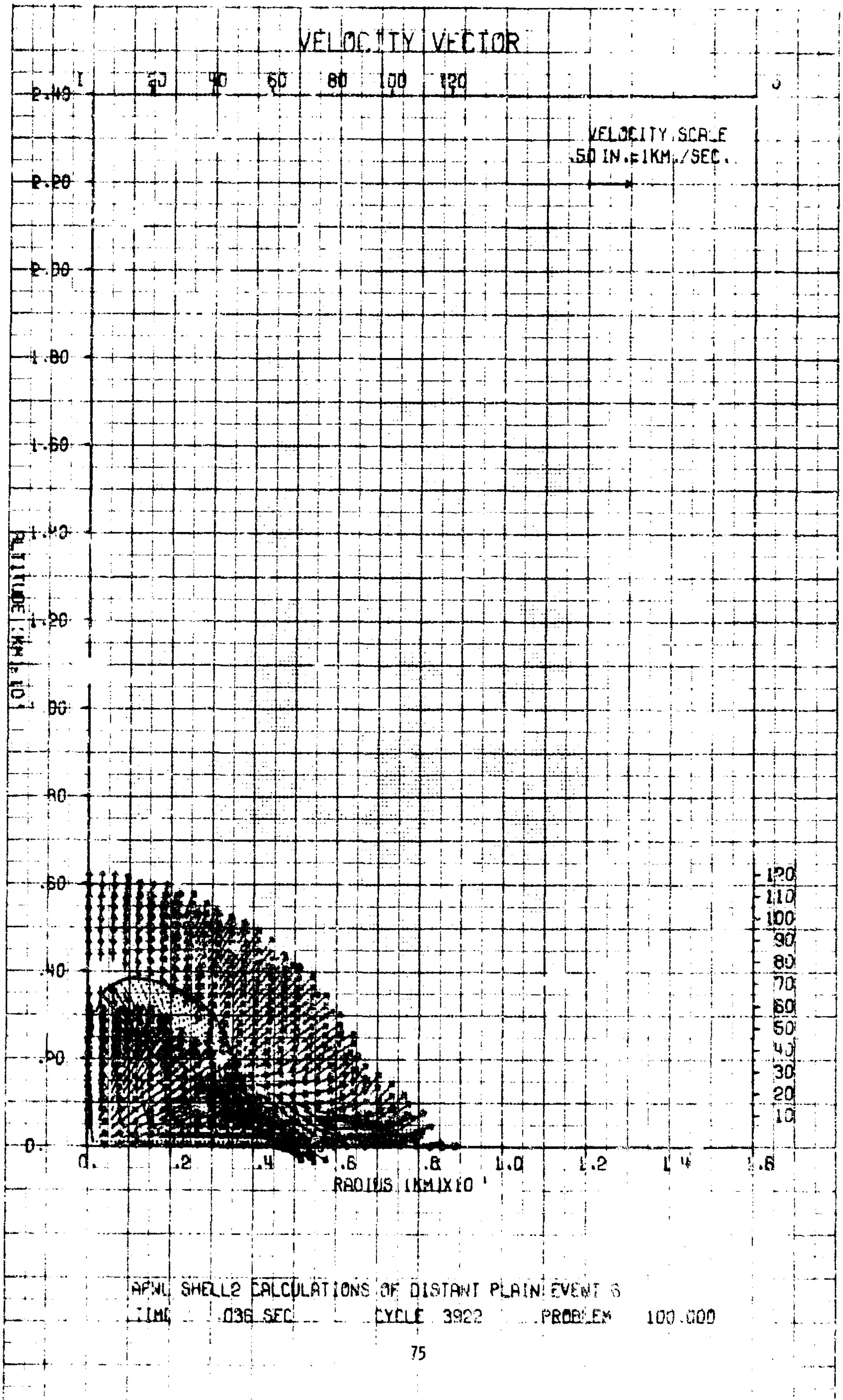
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .025 SEC CYCLE [illegible] PROBLEM 100.000

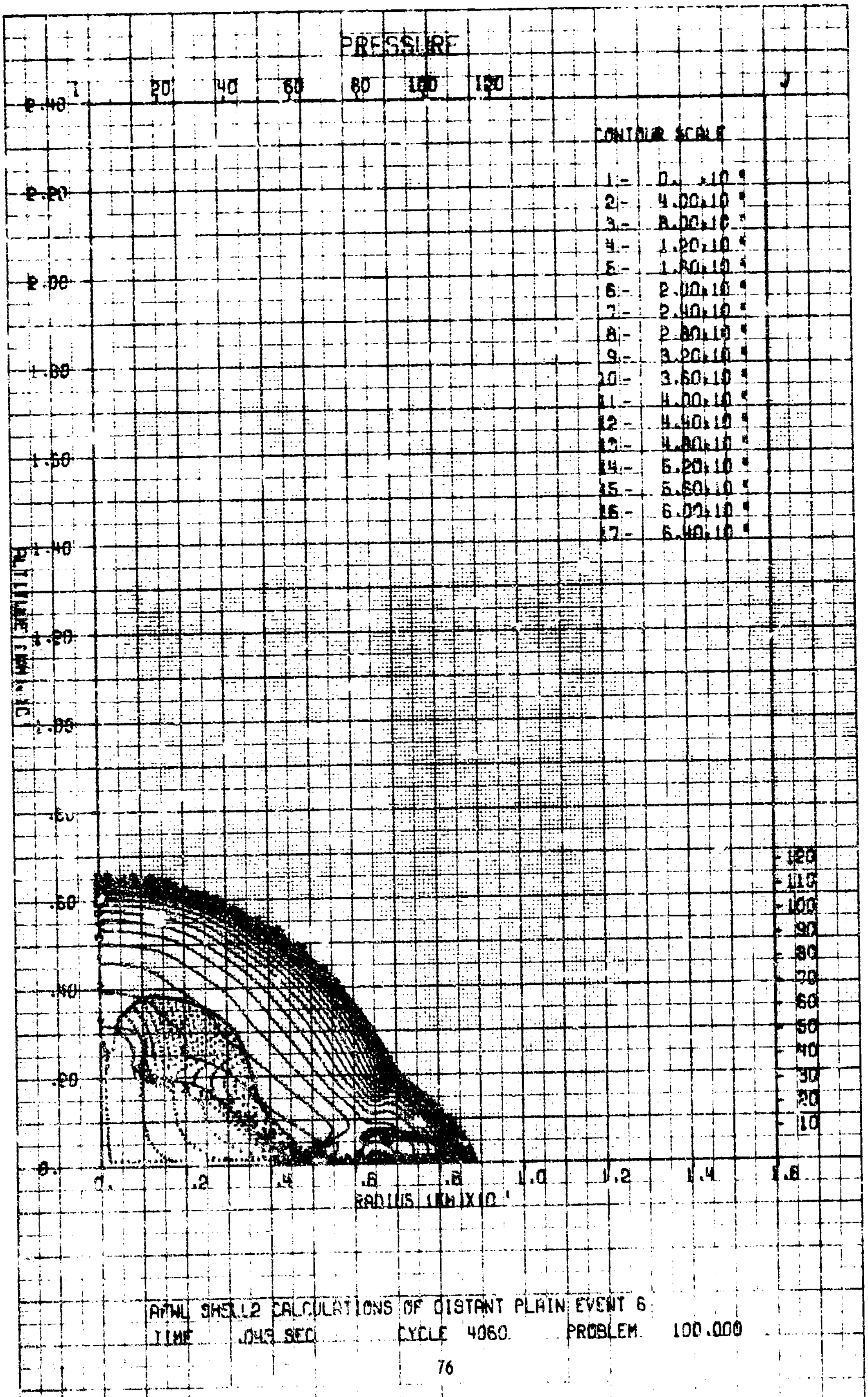


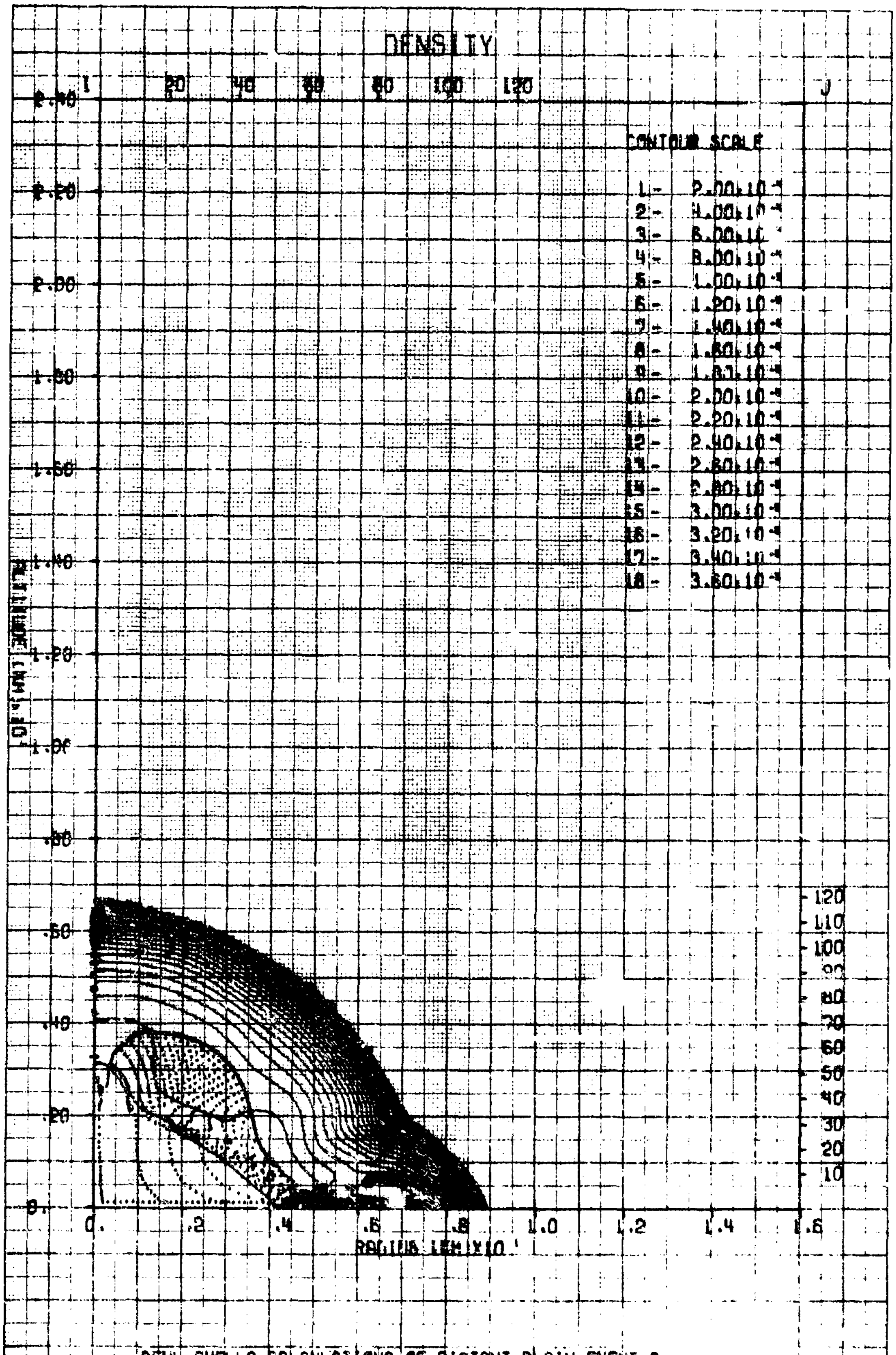
AFWL [illegible] CALCULATION OF DISTANT PLAIN EVENT [illegible]
TIME [illegible] SEC CYCLE [illegible] PROBLEM [illegible]



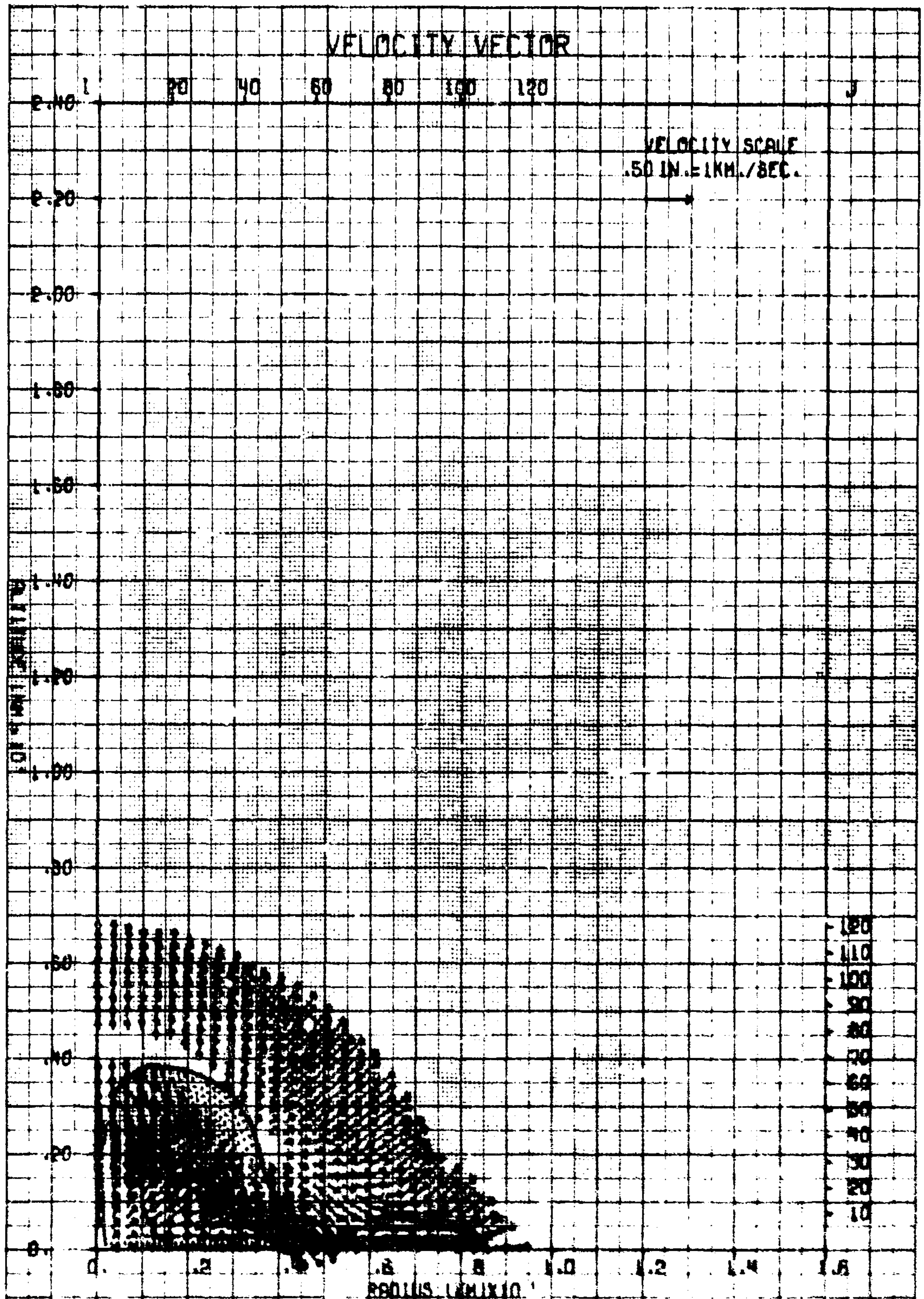
AFWL SHELL 2 CALCULATION OF DISTANT PLAIN EVEN
TIME ..036 SEC CYCLE [illegible] PROBLEM [illegible]


VELOCITY VECTOR
VELOCITY SCALE
.50 IN.=1KM./SEC.
ALTITUDE (KM)x10
RADIUS (KM)x10
APWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .036 SEC CYCLE 3922 PROBLEM 100.000

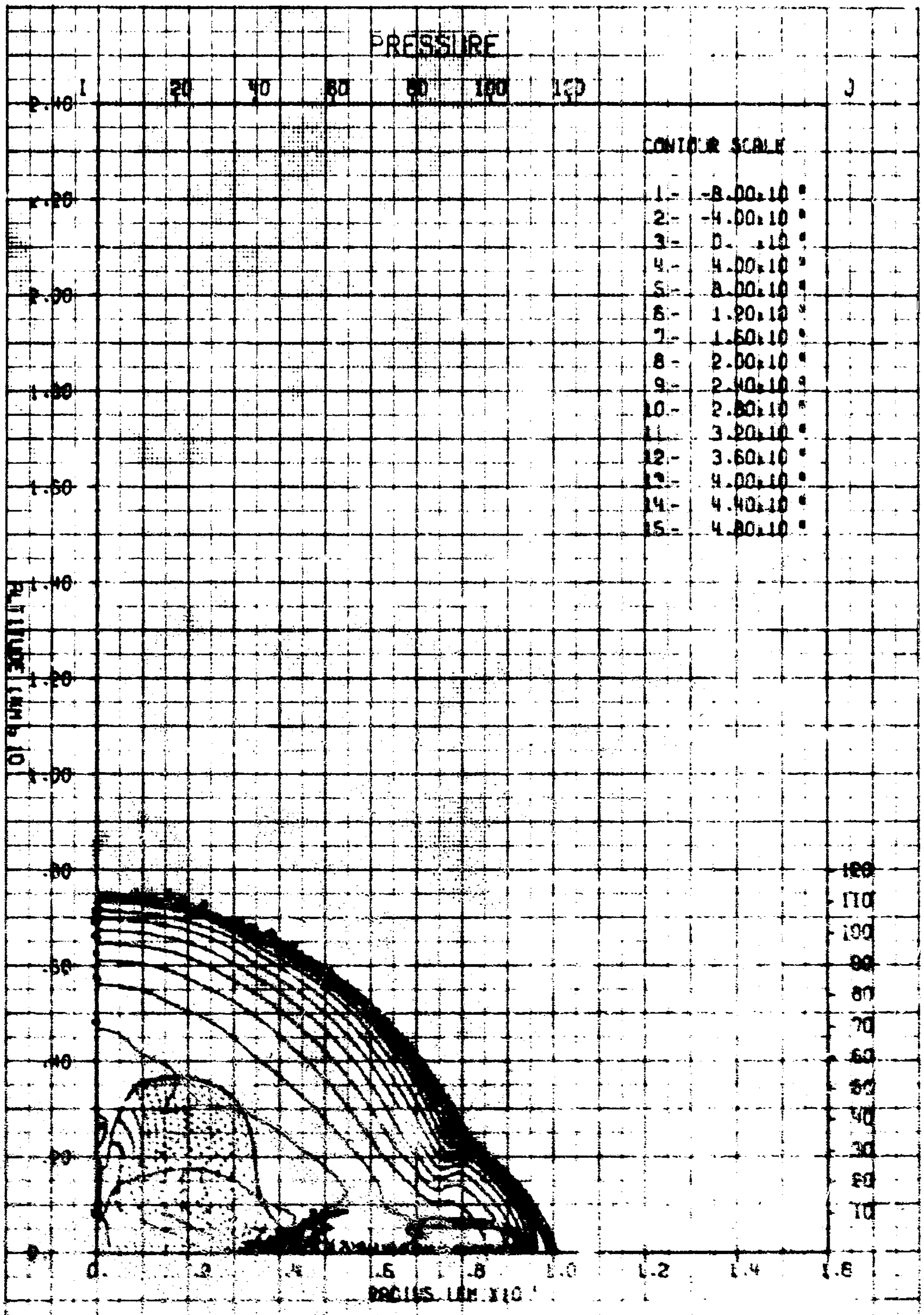

PRESSURE
CONTOUR SCALE
1.- 0.
2.- 4.00
3.- 8.00
4.- 1.20
5.- 1.60
6.- 2.00
7.- 2.40
8.- 2.80
9.- 3.20
10.- 3.60
11.- 4.00
12.- 4.40
13.- 4.80
14.- 5.20
15.- 5.60
16.- 6.00
17.- 6.40
RADIUS (KM)X10
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .043 SEC CYCLE 4060 PROBLEM 100.000



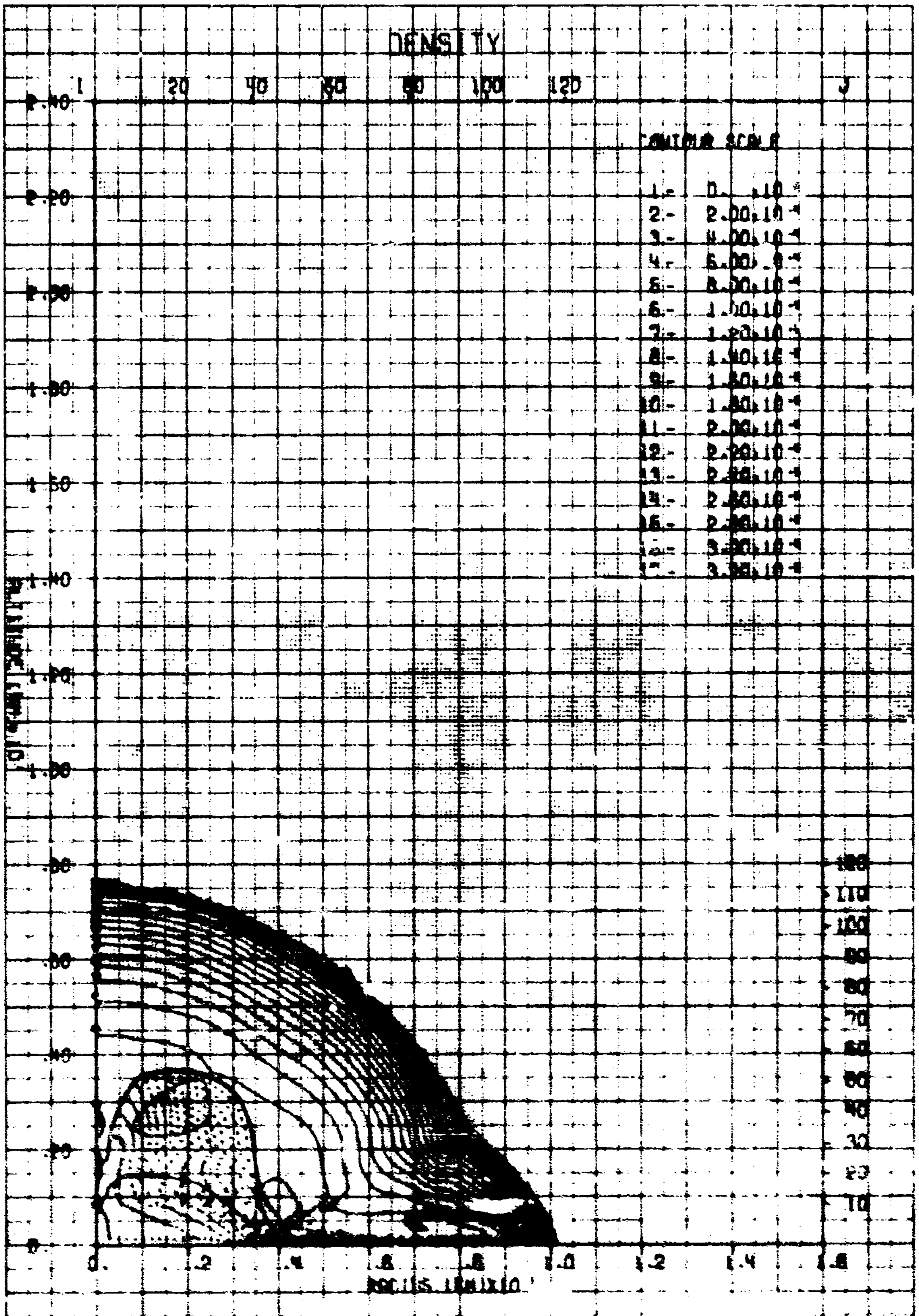
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .005 SEC CYCLE 4060 PROBLEM 100.000



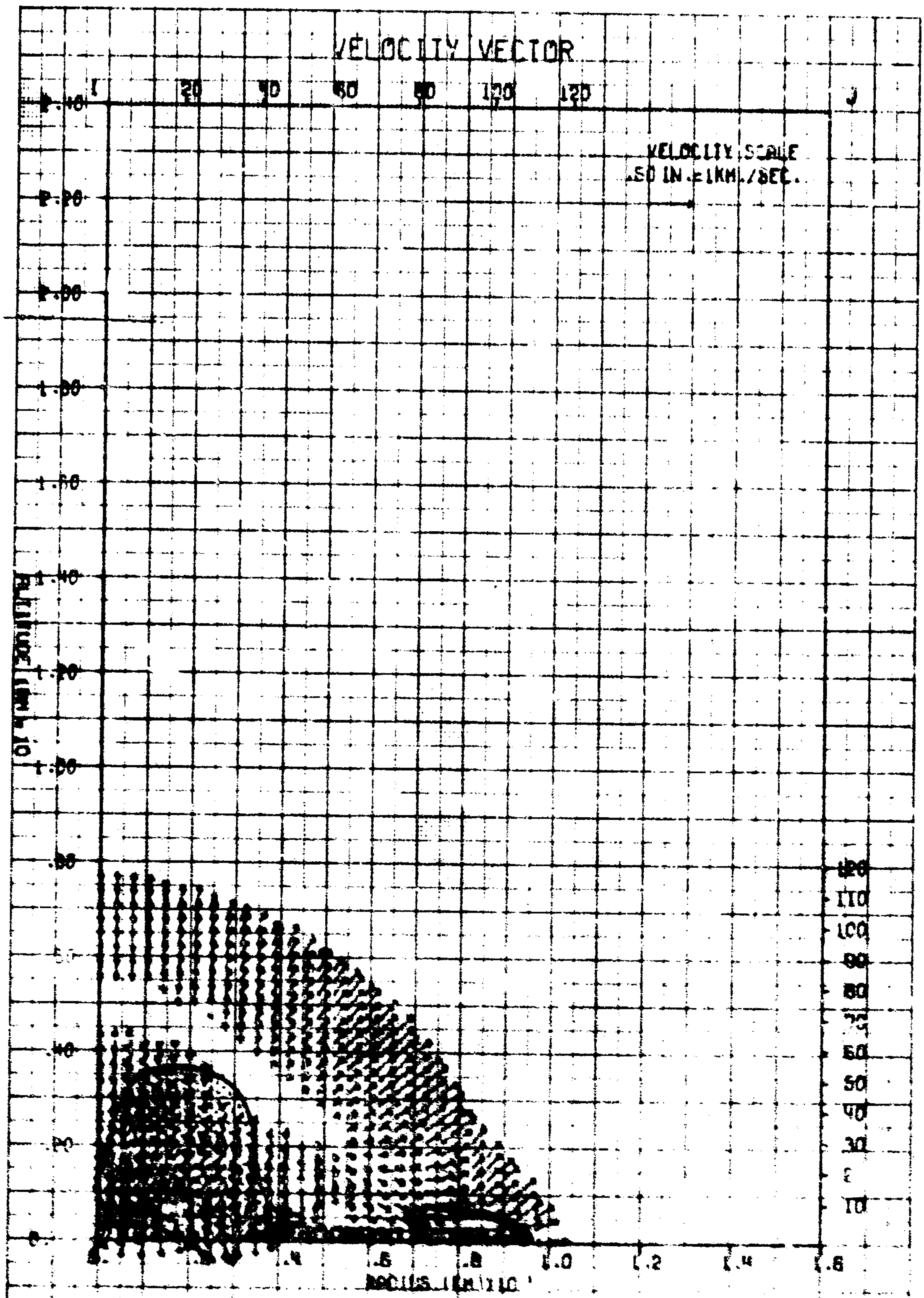
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .048 SEC. CYCLE 4060 PROBLEM 100.000



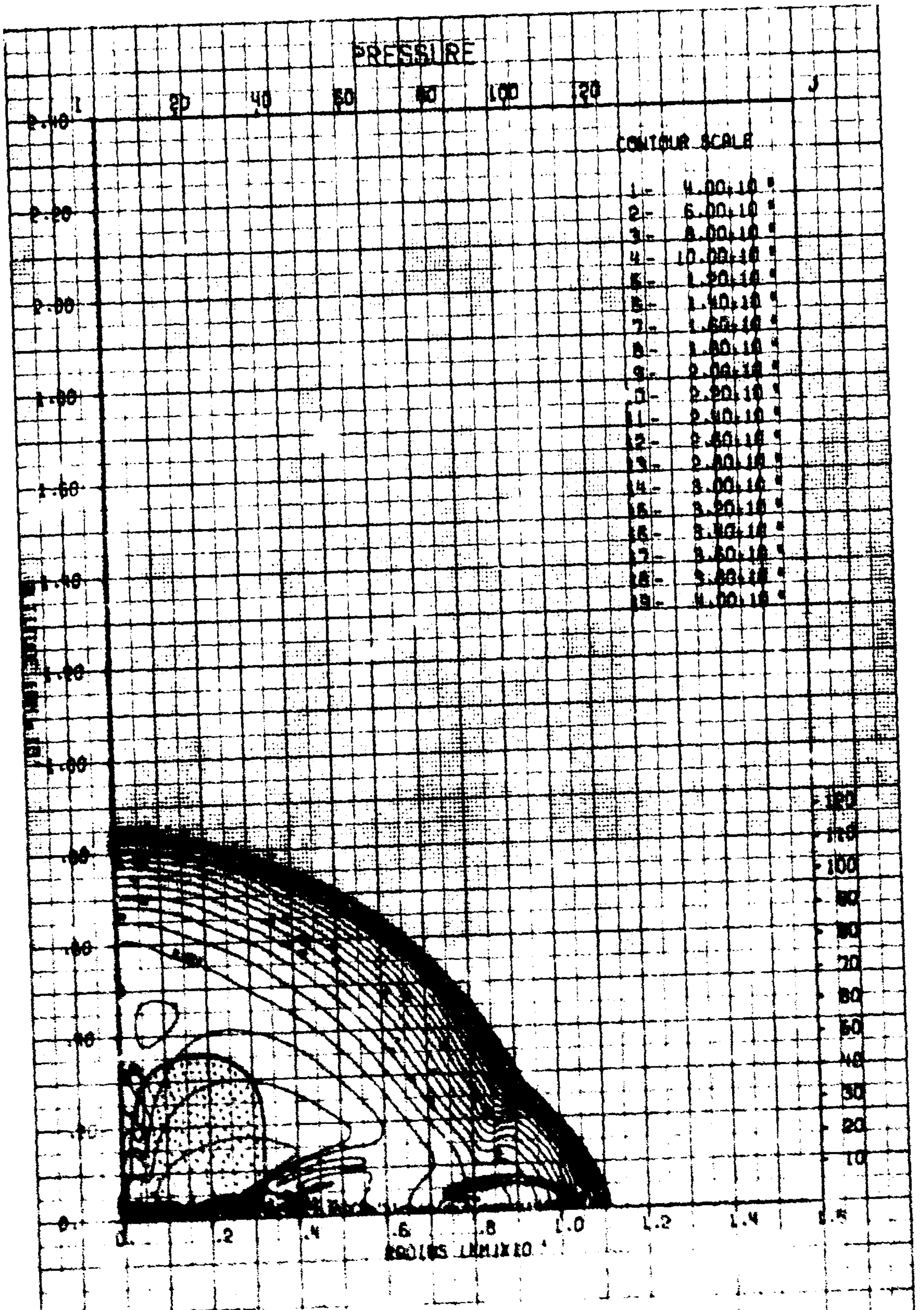
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .060 SEC CYCLE 4241 PROBLEM 100.000



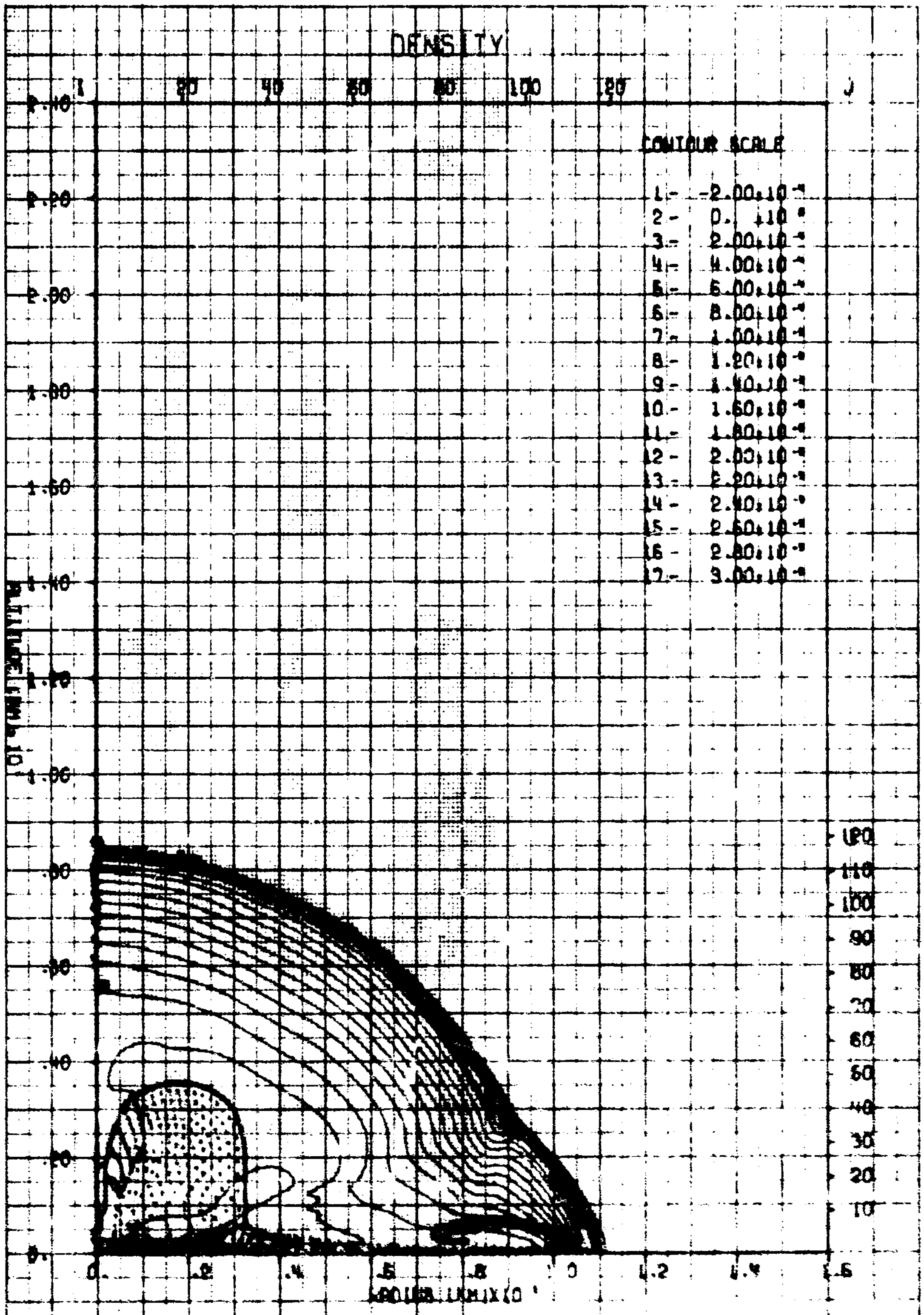
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .060 SEC. CYCLE 424 PROBLEM 100.000



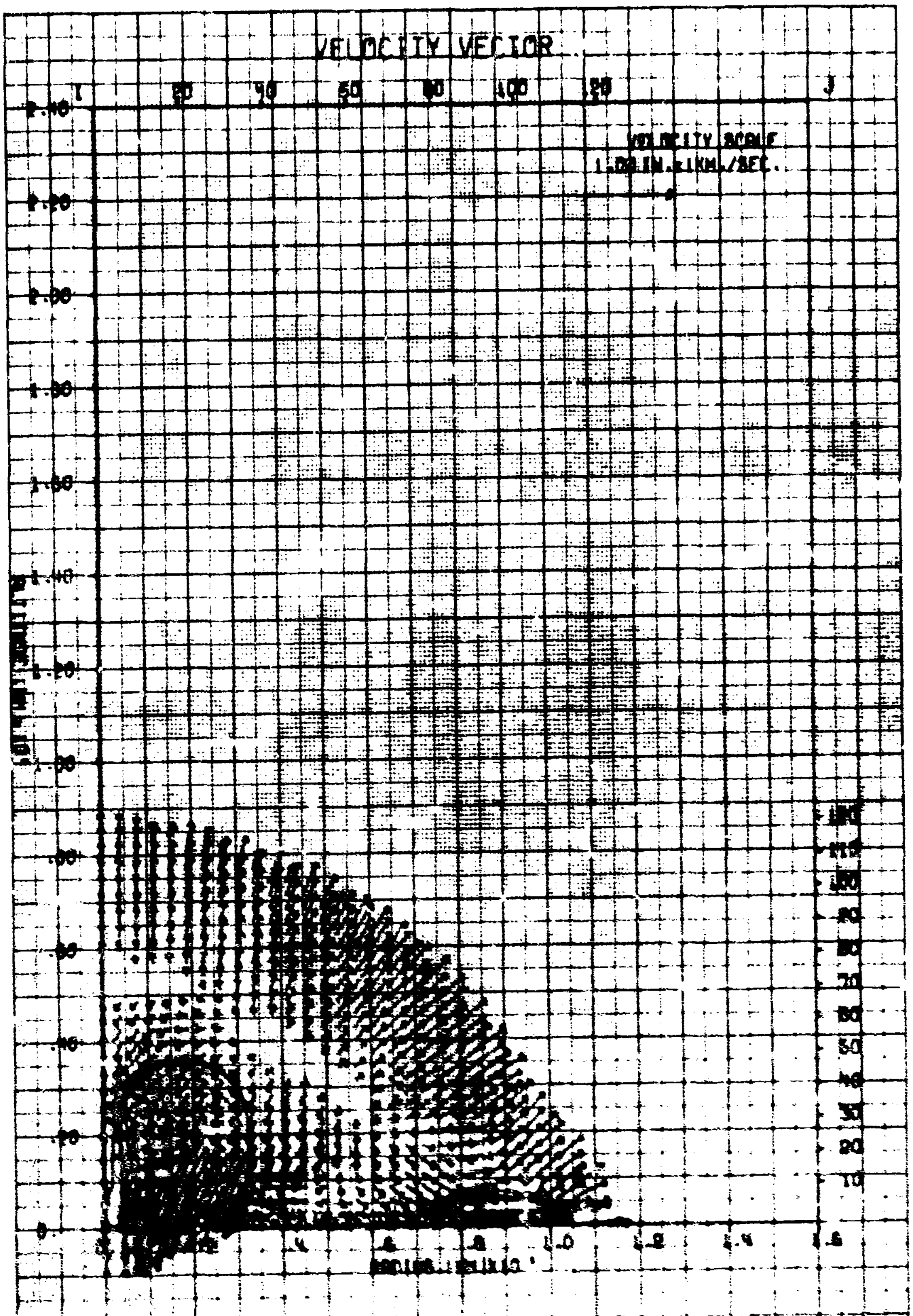
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .060 SEC CYCLE [illegible] PROBLEM 100.000



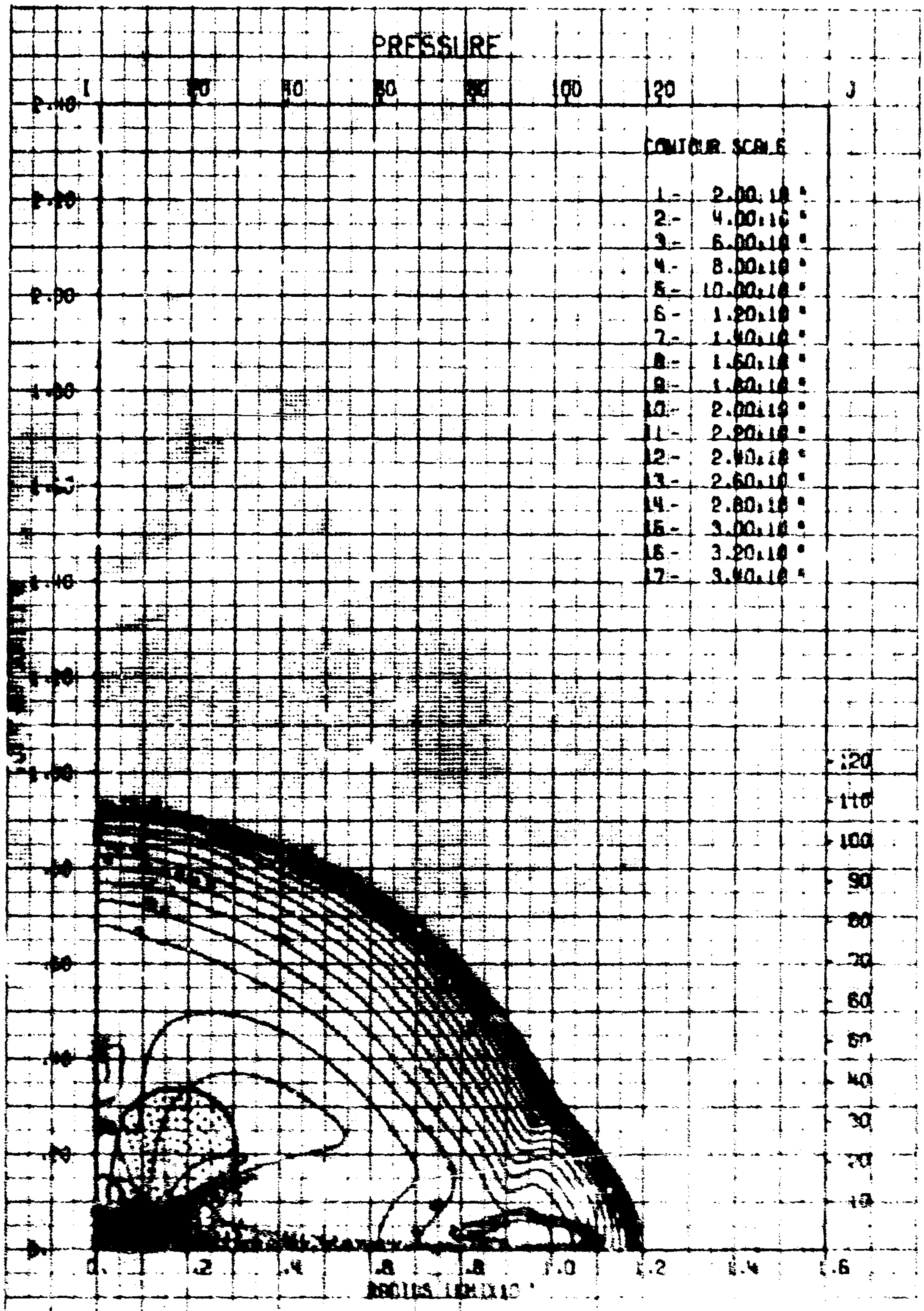
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .075 SEC. CYCLE 4428 PROBLEM 100.000



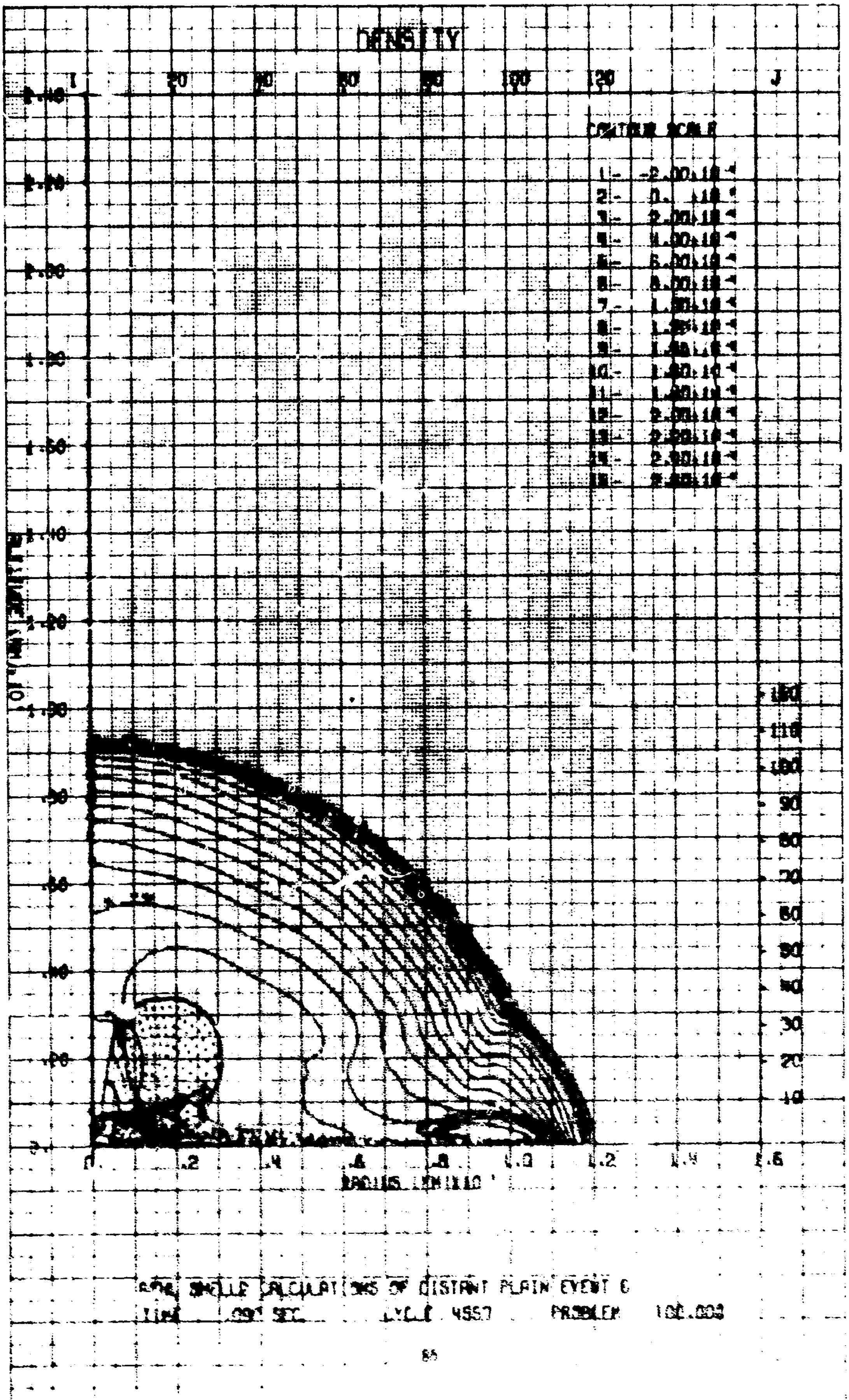
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .076 SEC CYCLE 4428 PROBLEM 10 .000

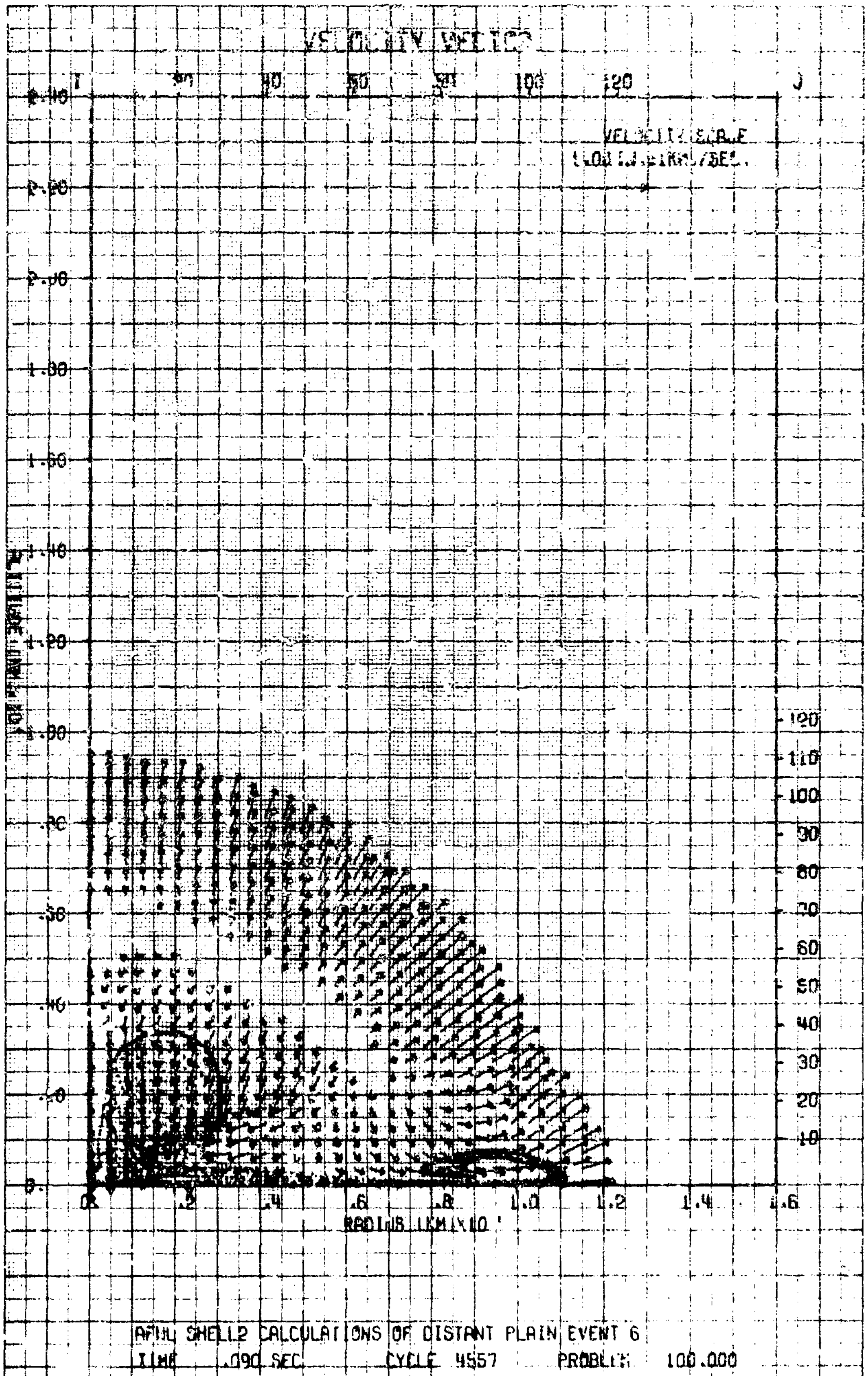


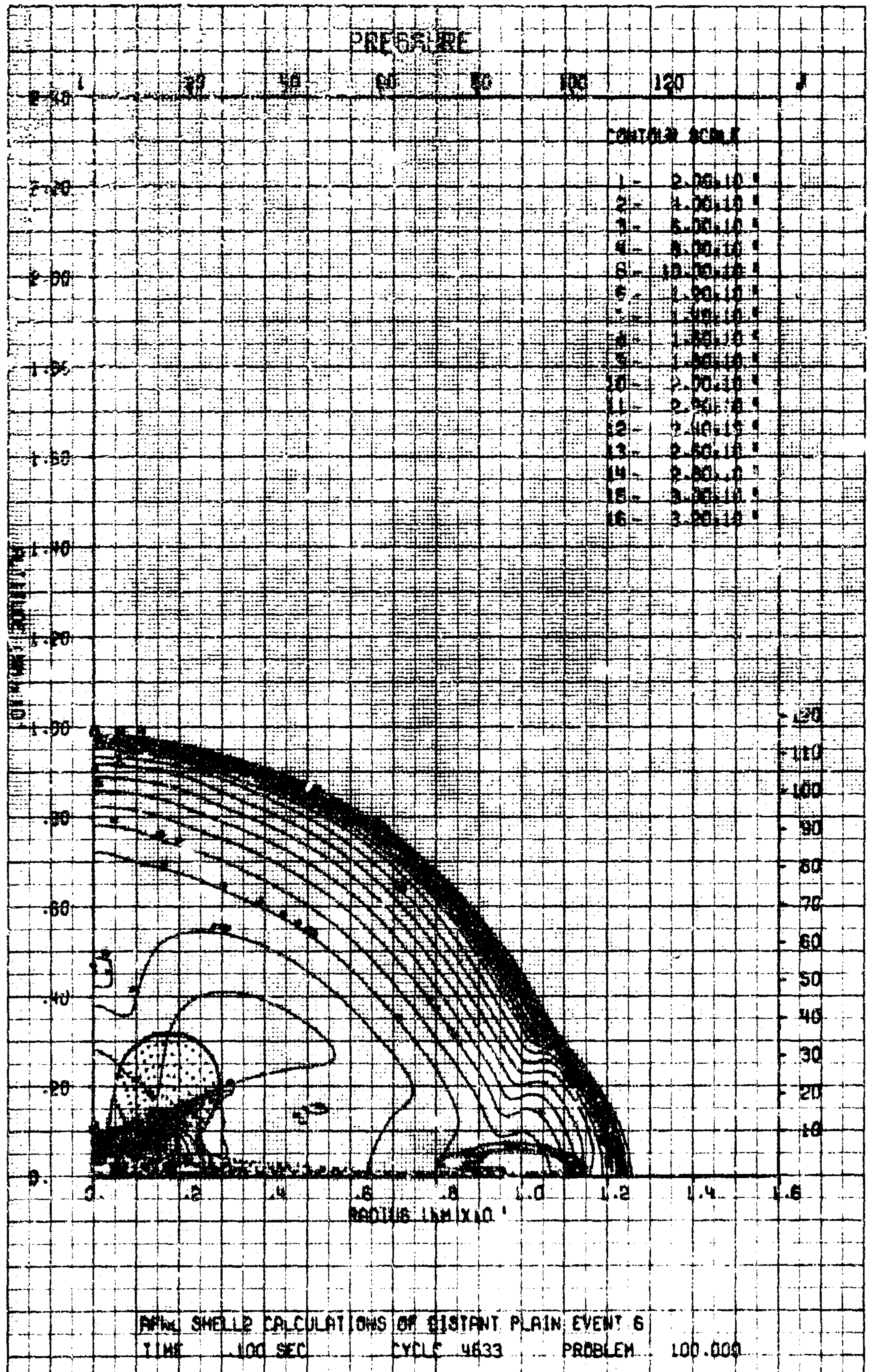
SHELL CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .035 SEC. CYCLE 4428 PROBLEM 100.303

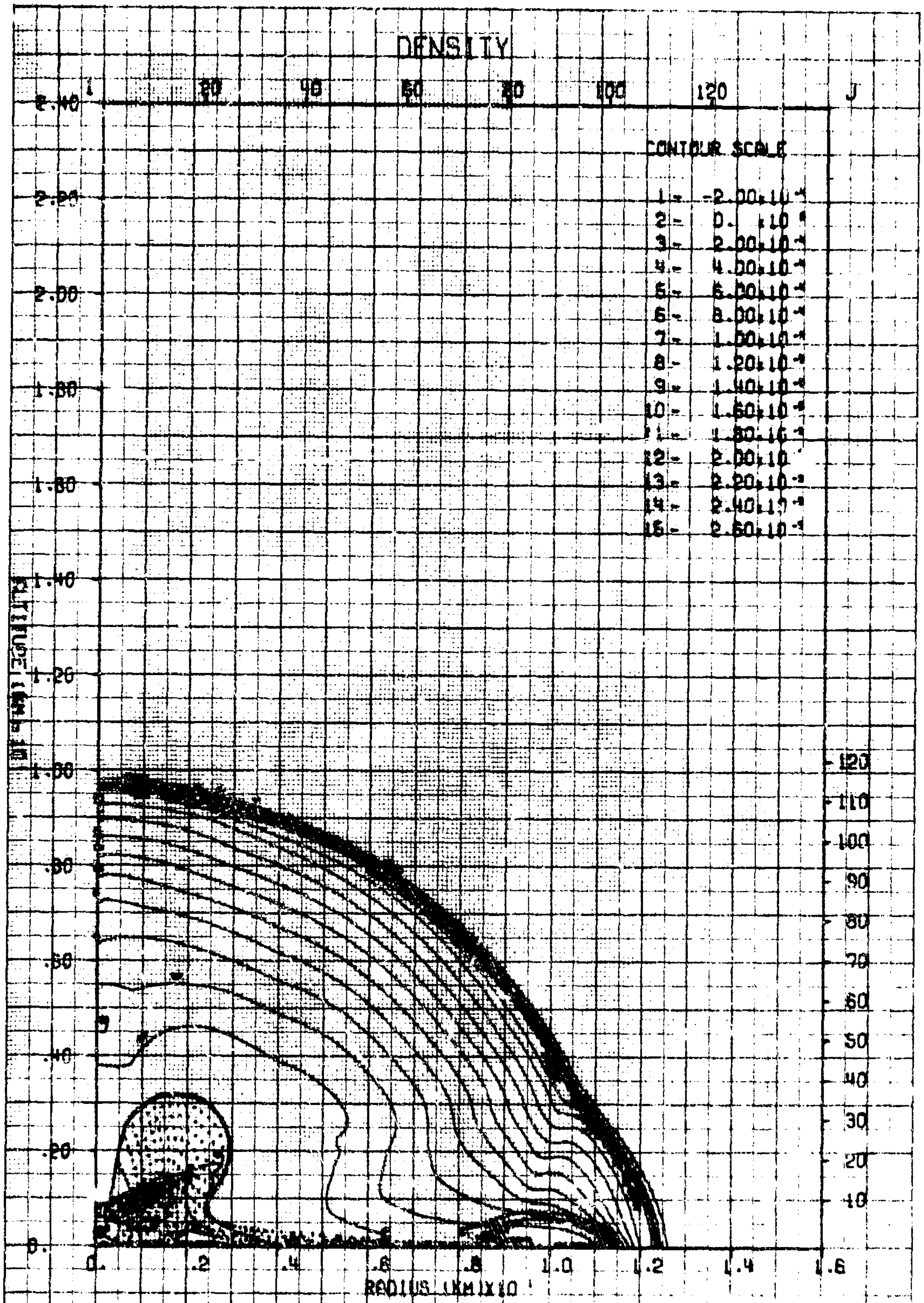


SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME [illegible] SEC CYCLE [illegible] PROBLEM [illegible]

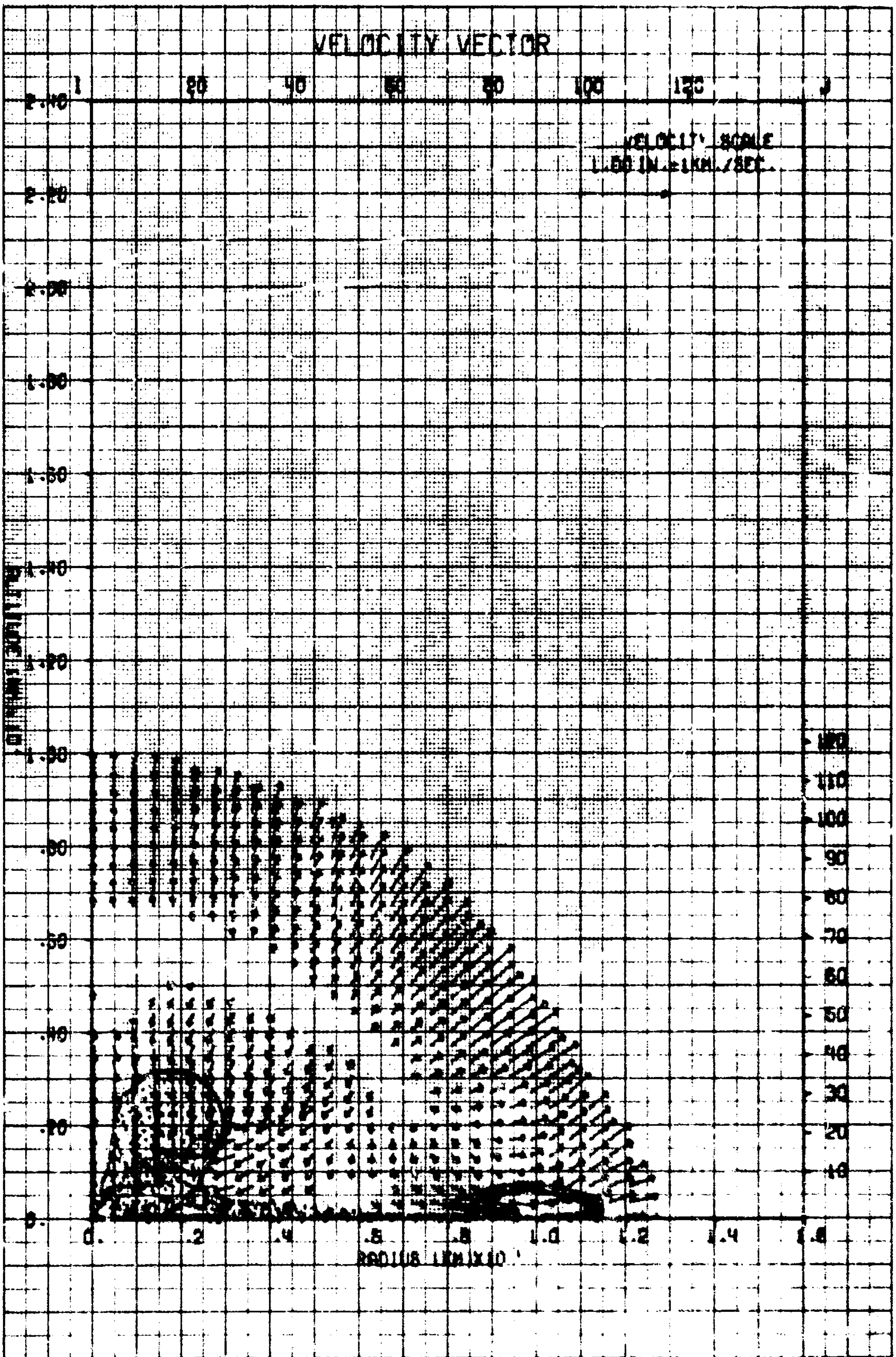

DENSITY
CONTOUR SCALE
I
J
20
120
150
90
80
70
60
50
40
30
20
10
.2
.4
.6
.8
1.6


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .090 SEC CYCLE 4557 100.000

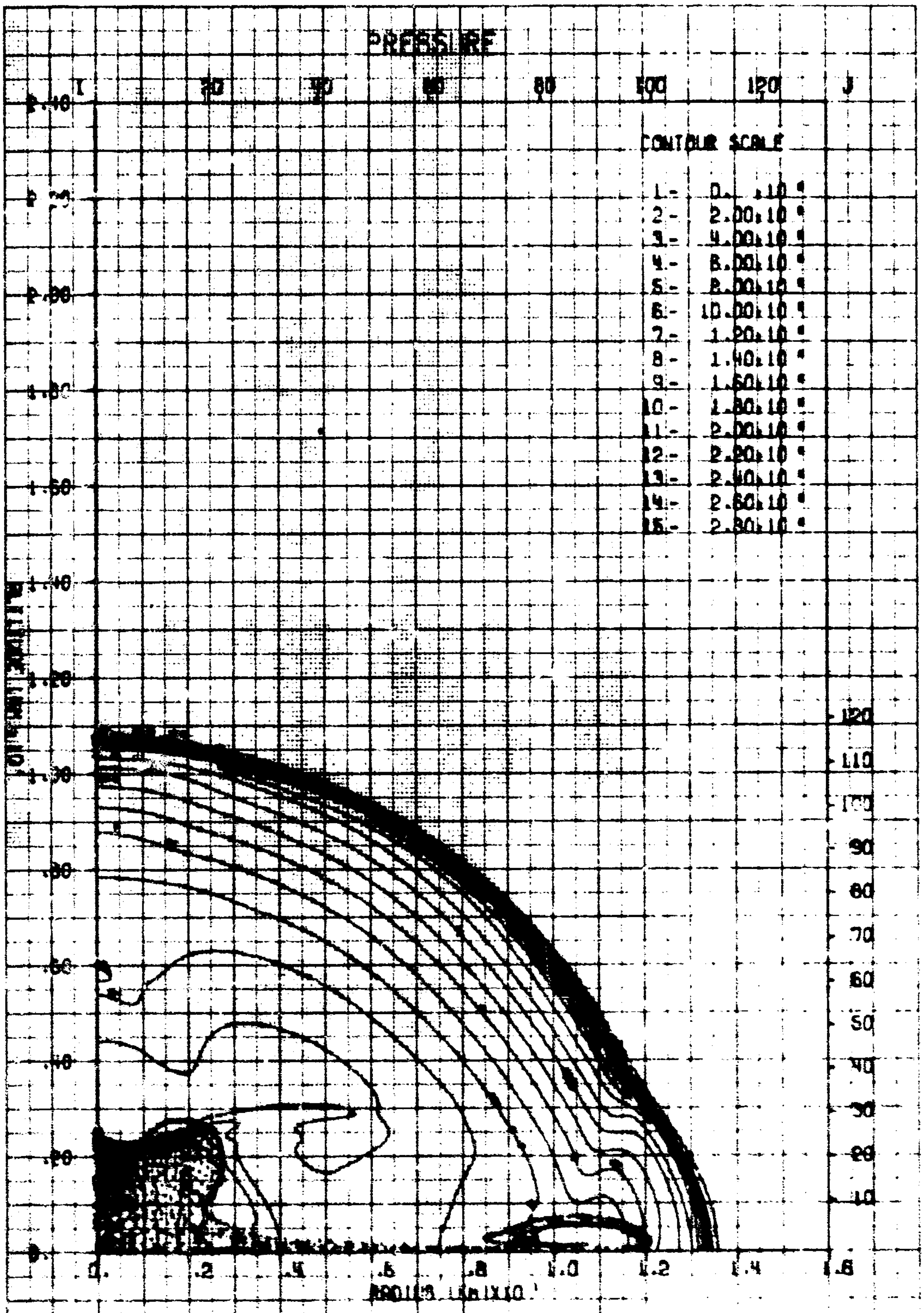

PRESSURE
CONTOUR SCALE
RADIUS (KM X10)
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME 100 SEC CYCLE 4633 PROBLEM 100.000



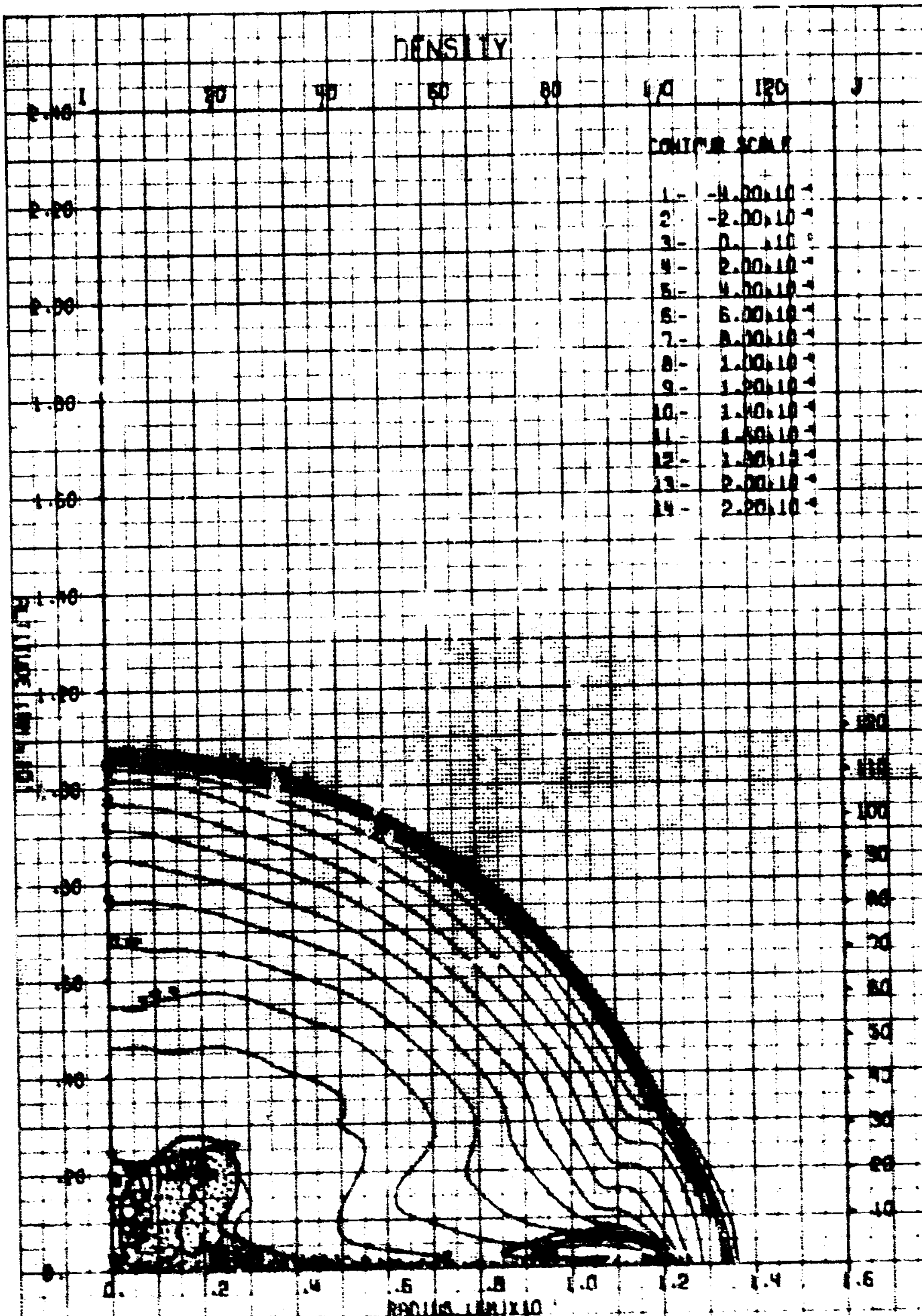
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME 100 SEC CYCLE 4633 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .100 SEC CYCLE 4633 PROBLEM 100.000

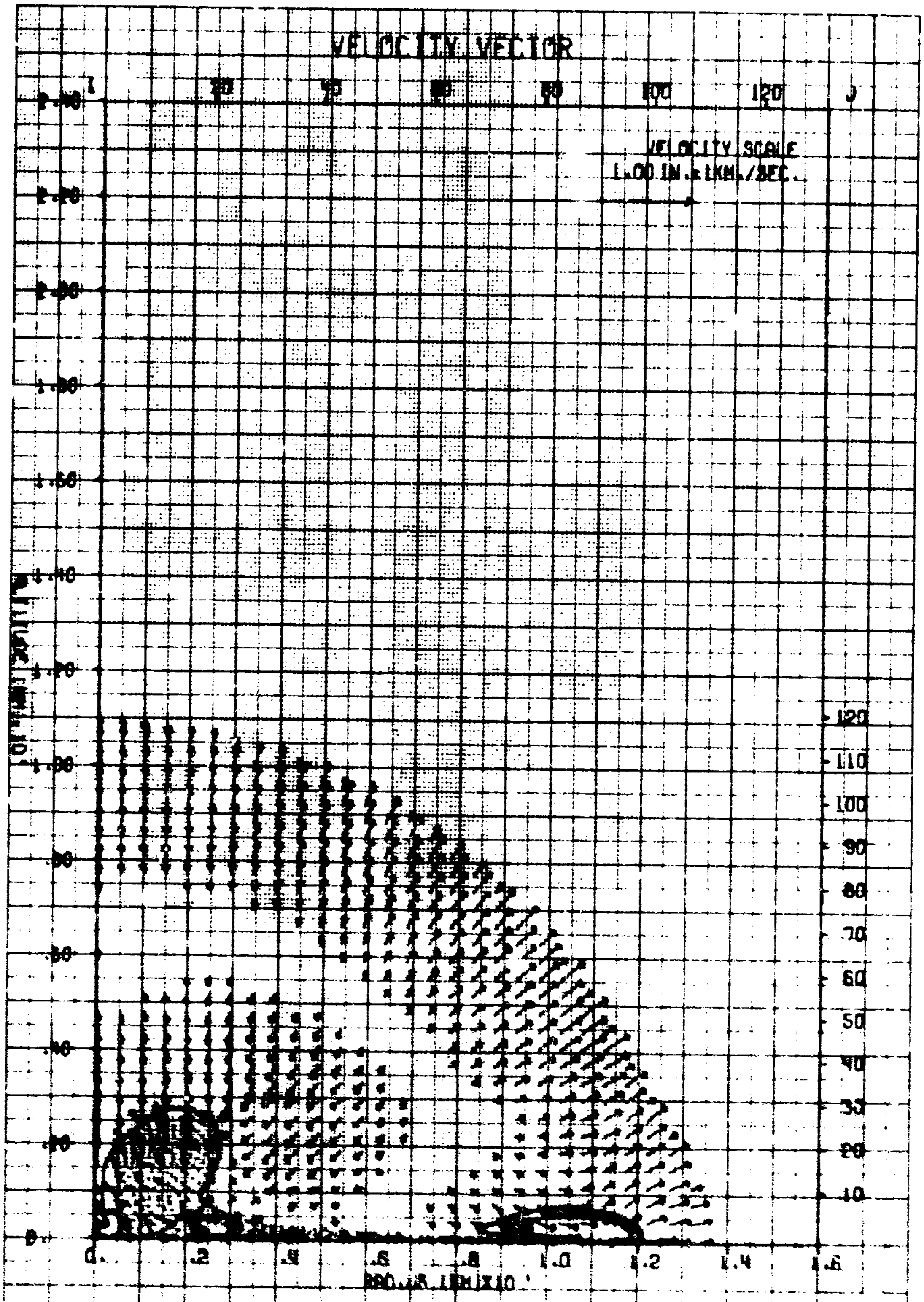


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .120 SEC CYCLE 4775 PROBLEM 100.000

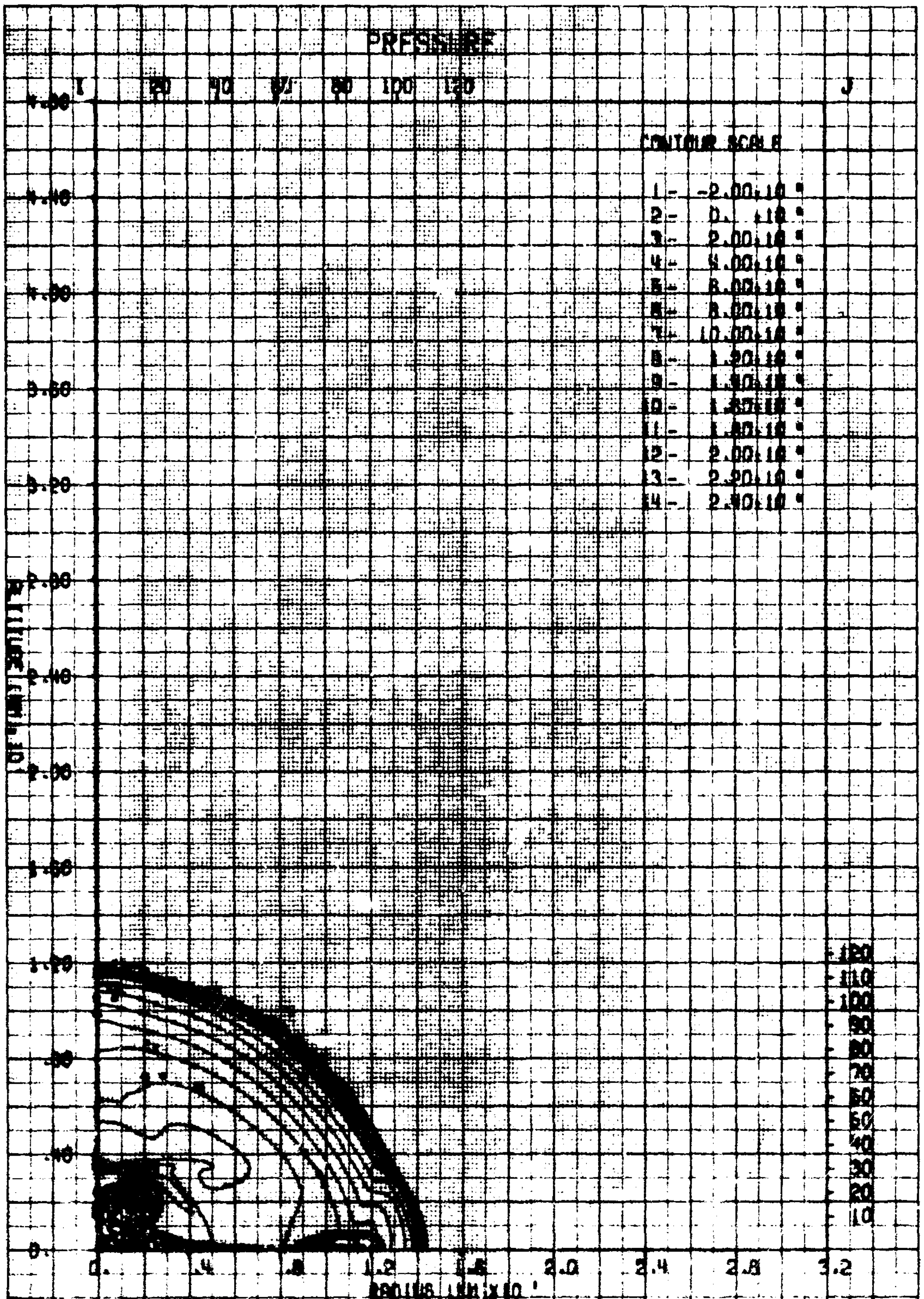


AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6

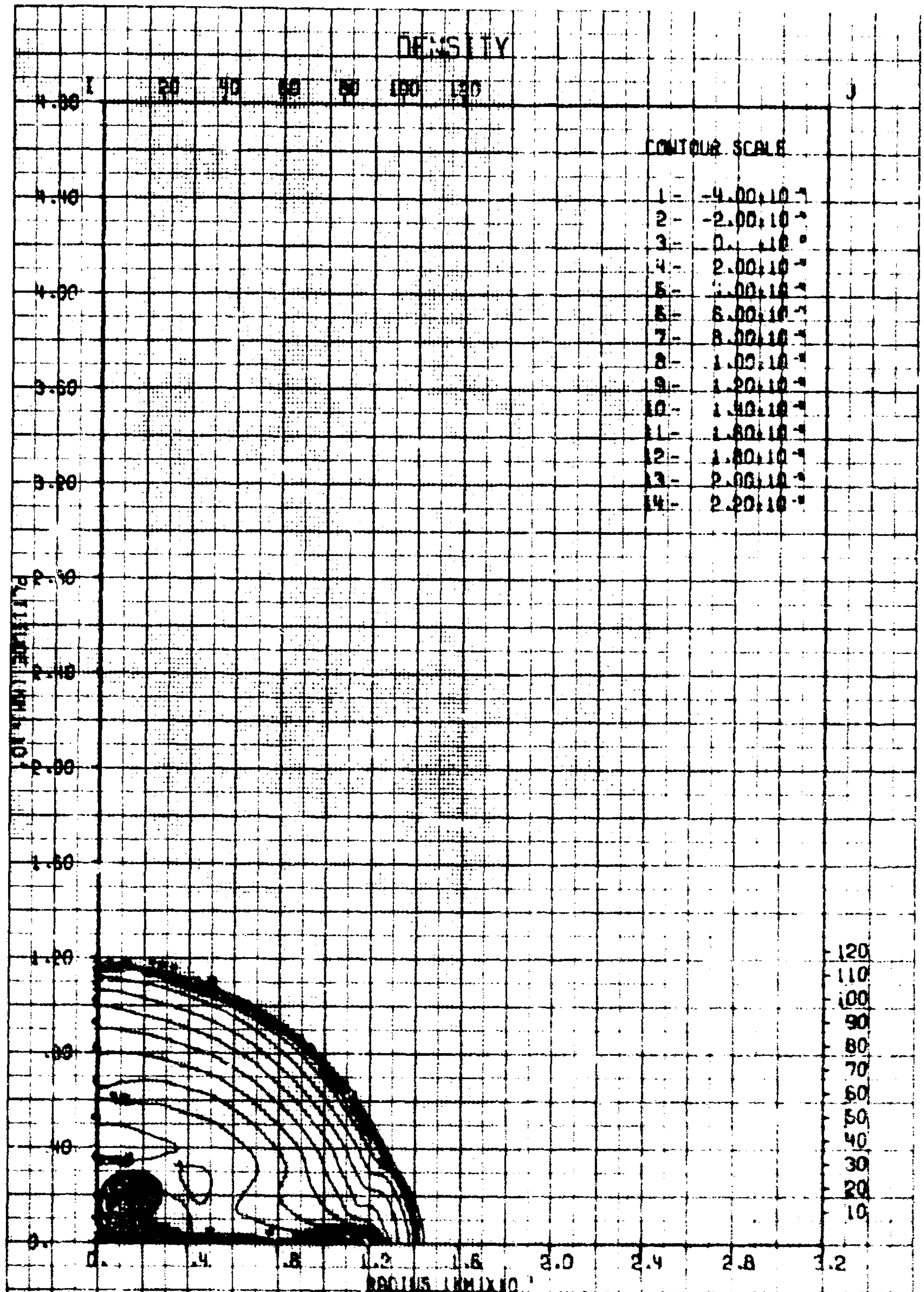
TIME .121 SEC CYCLE 4775 PROBLEM 100.000



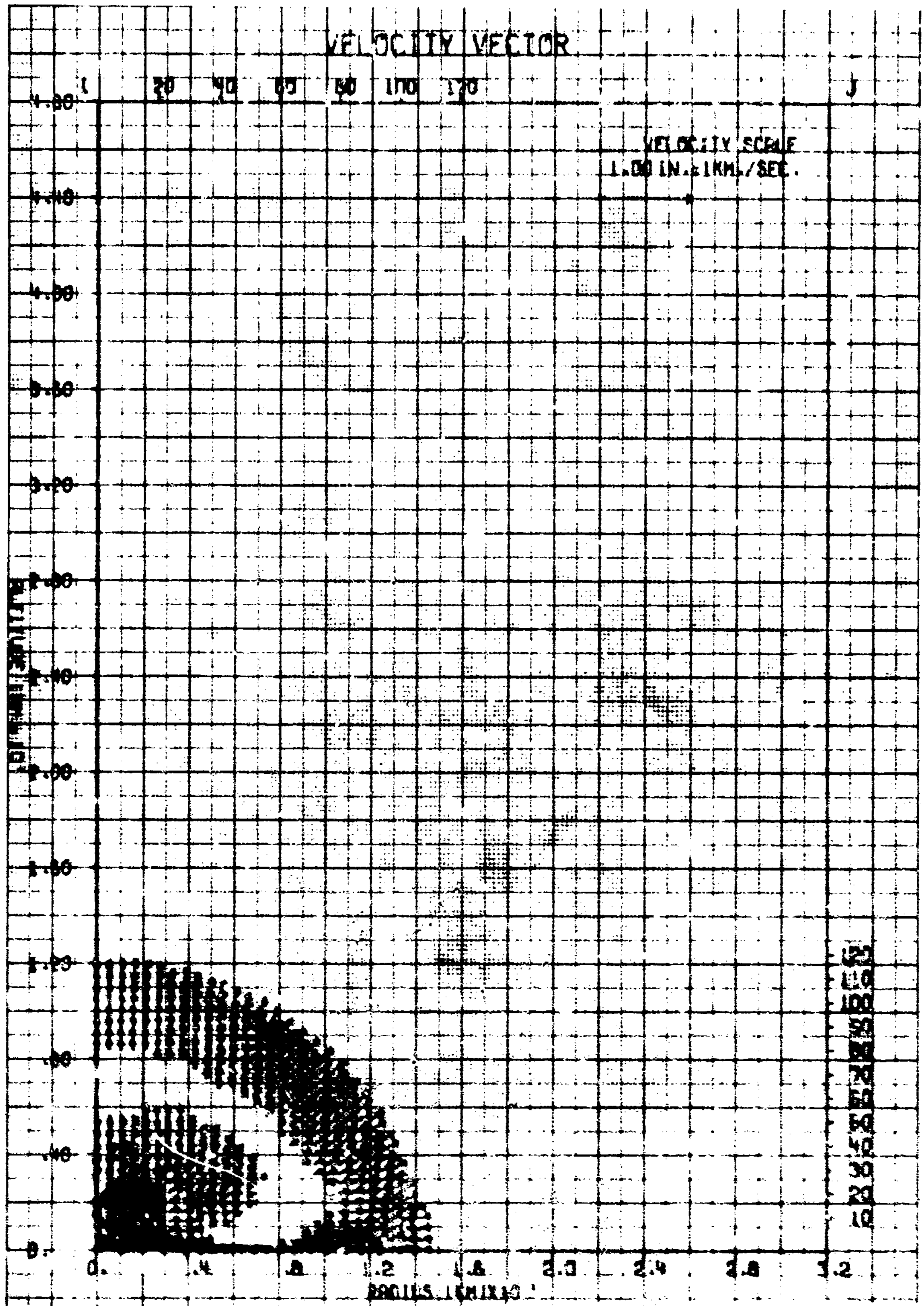
CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .000 SEC CYCLE 4775 PROBLEM 100.000



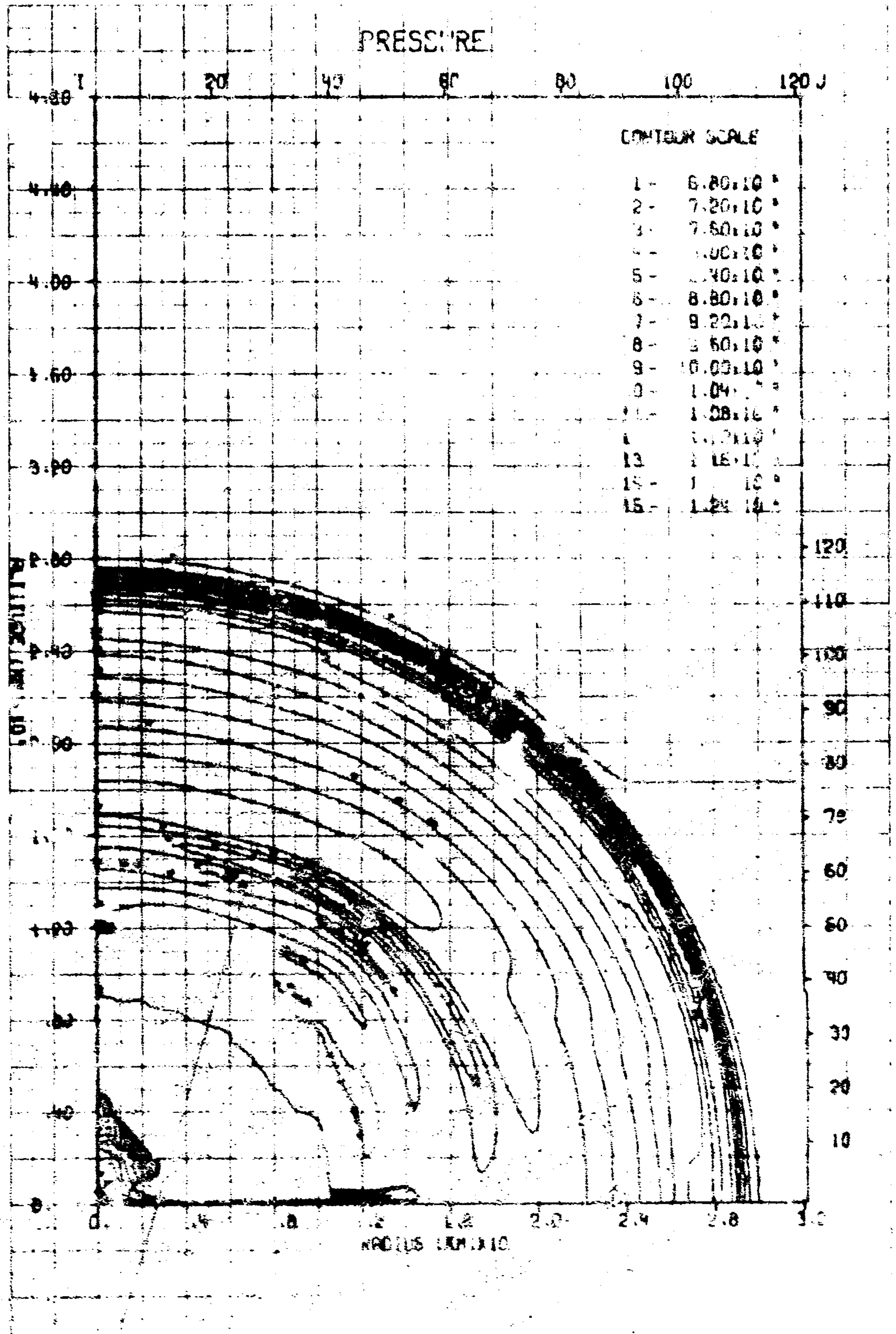
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME [illegible] SEC CYCLE 4884 PROBLEM 100.000



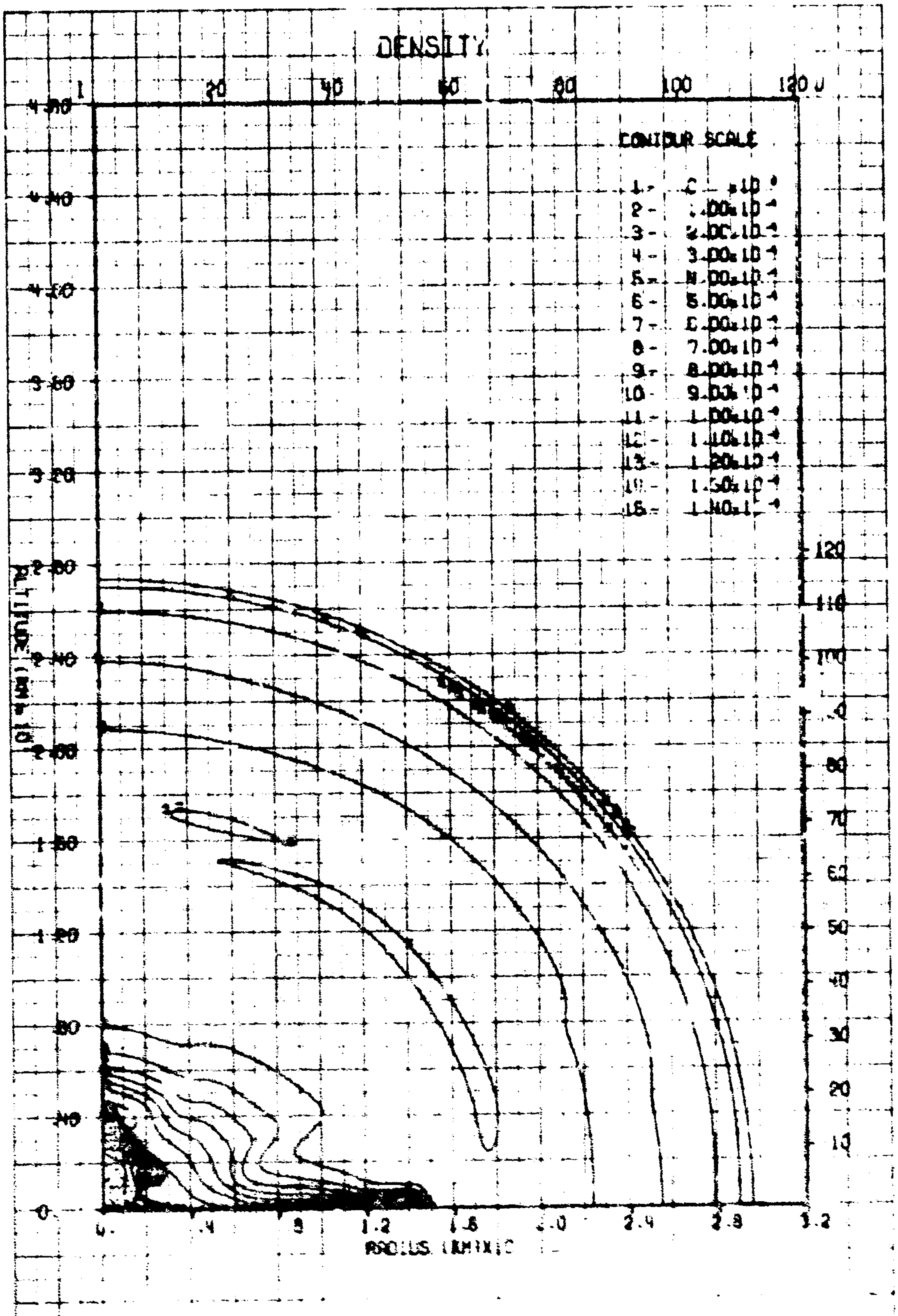
AFWL SHELLP CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .139 SEC CYCLE 4684 PROBLEM 100.000



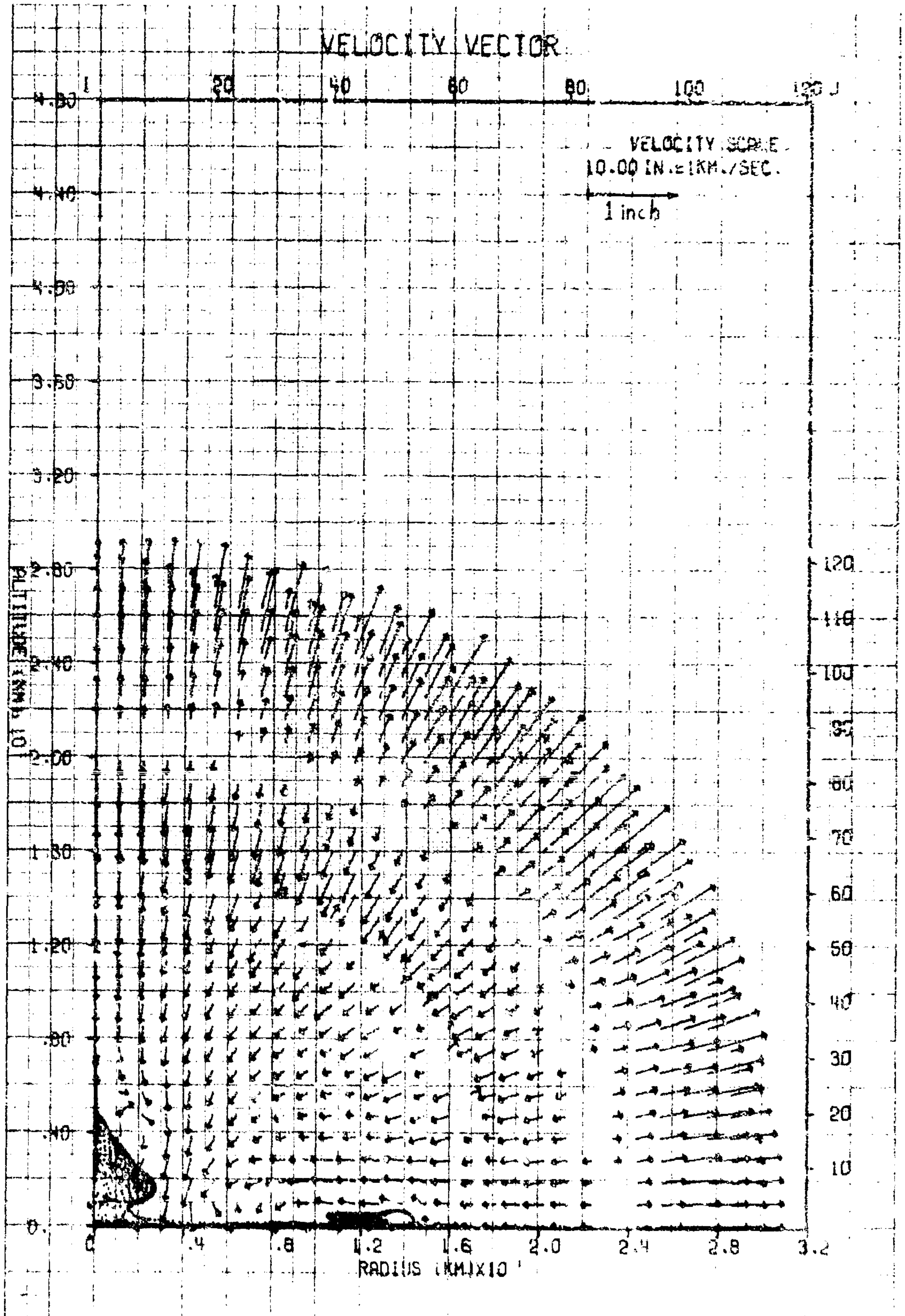
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .139 SEC CYCLE 4884 PROBLEM 100.000



AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME [illegible] SEC CYCLE 5933 PROBLEM 100.000



AFWL SHELLS CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .530 SEC CYCLE 5893 PROBLEM 100.000

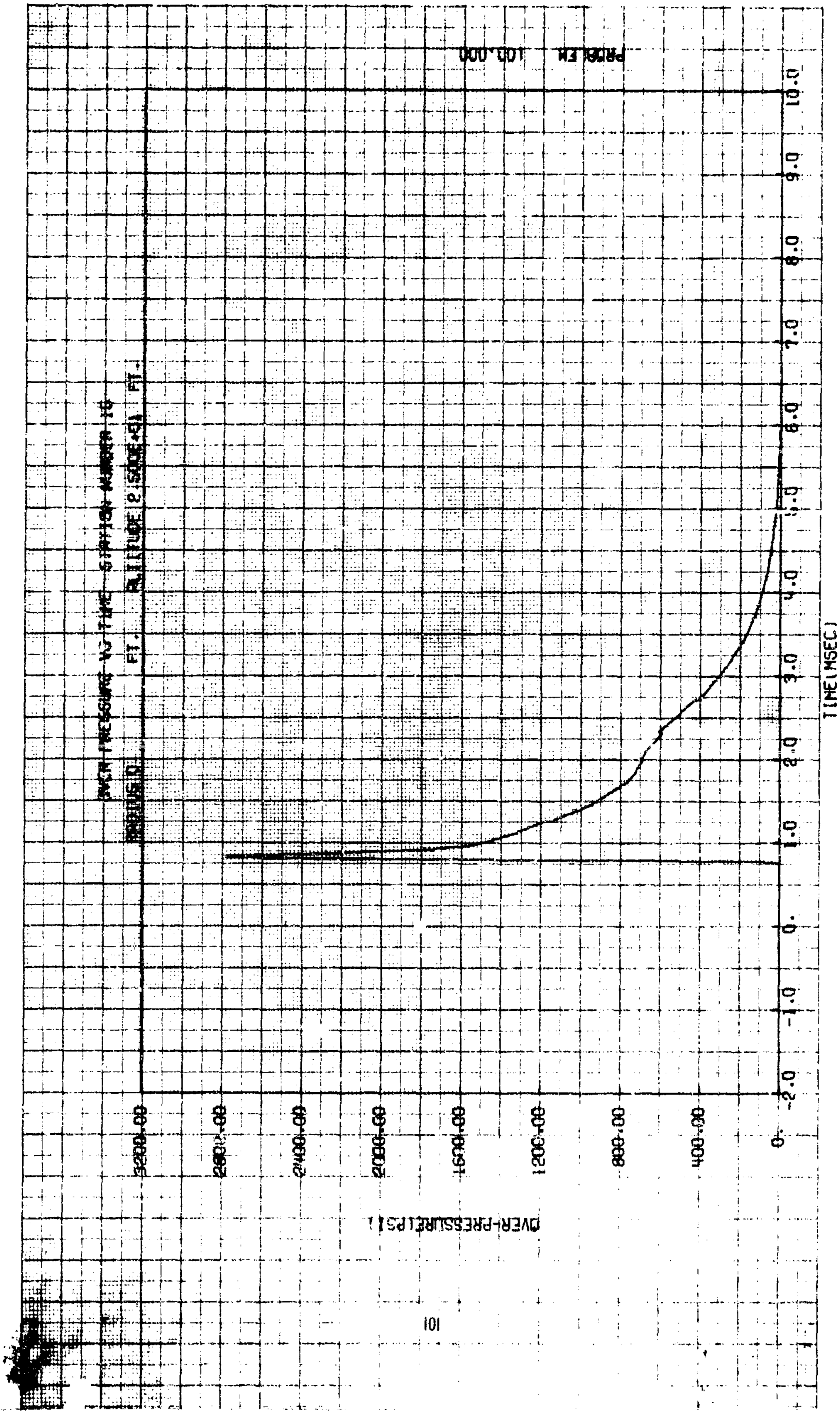


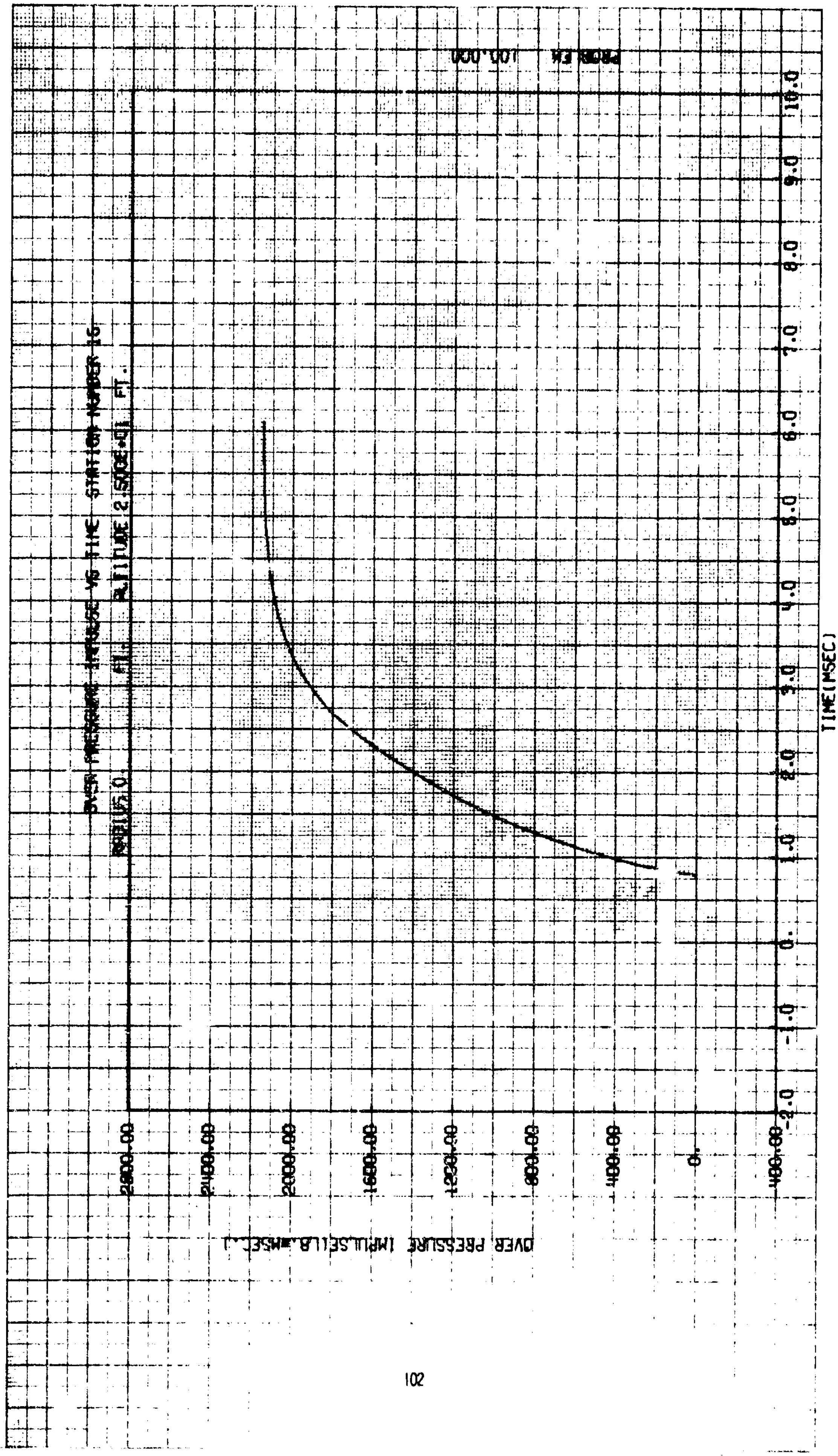
AFWL SHELL2 CALCULATIONS OF DISTANT PLAIN EVENT 6
TIME .530 SEC CYCLE 5993 PROBLEM 100.000

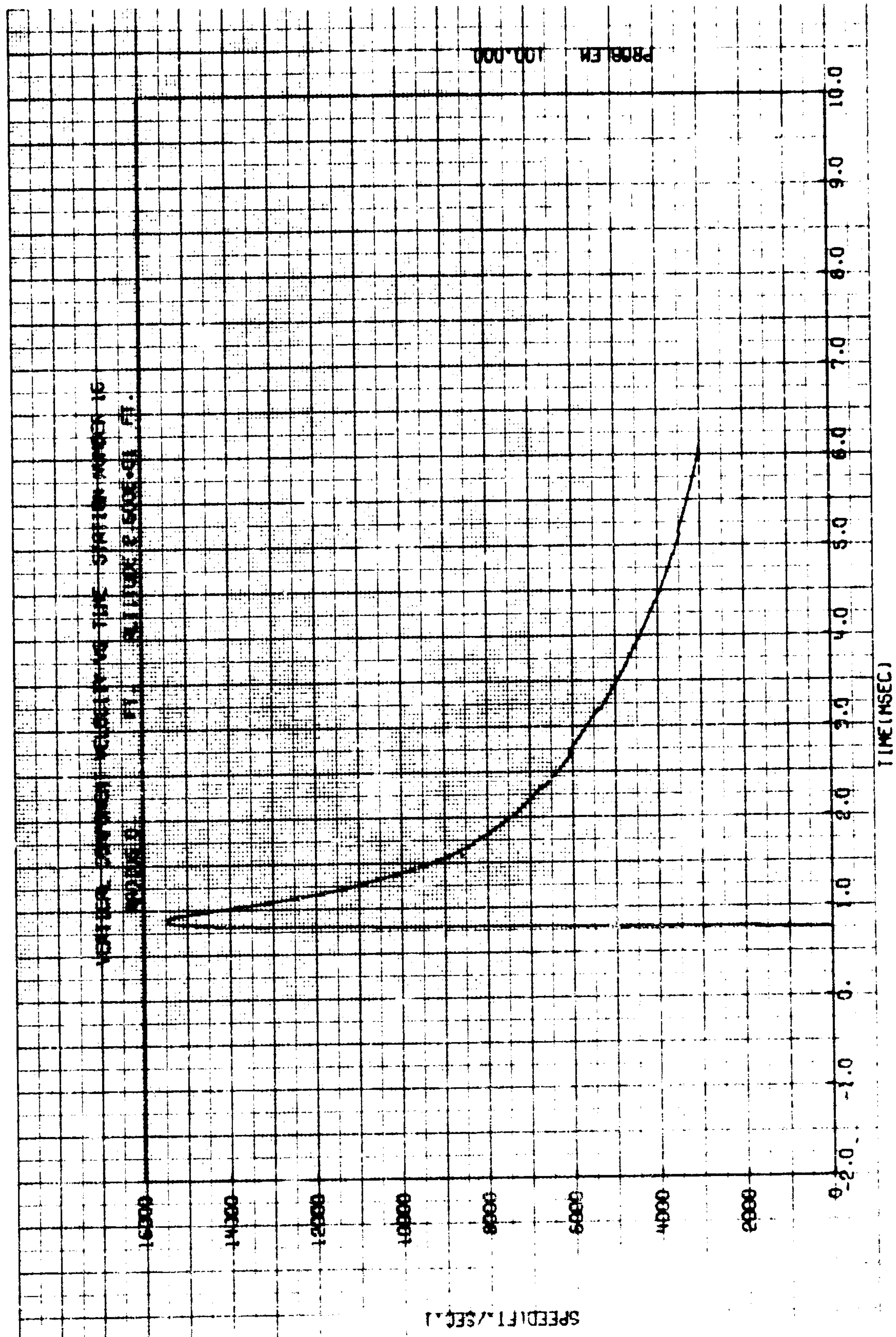
APPENDIX II

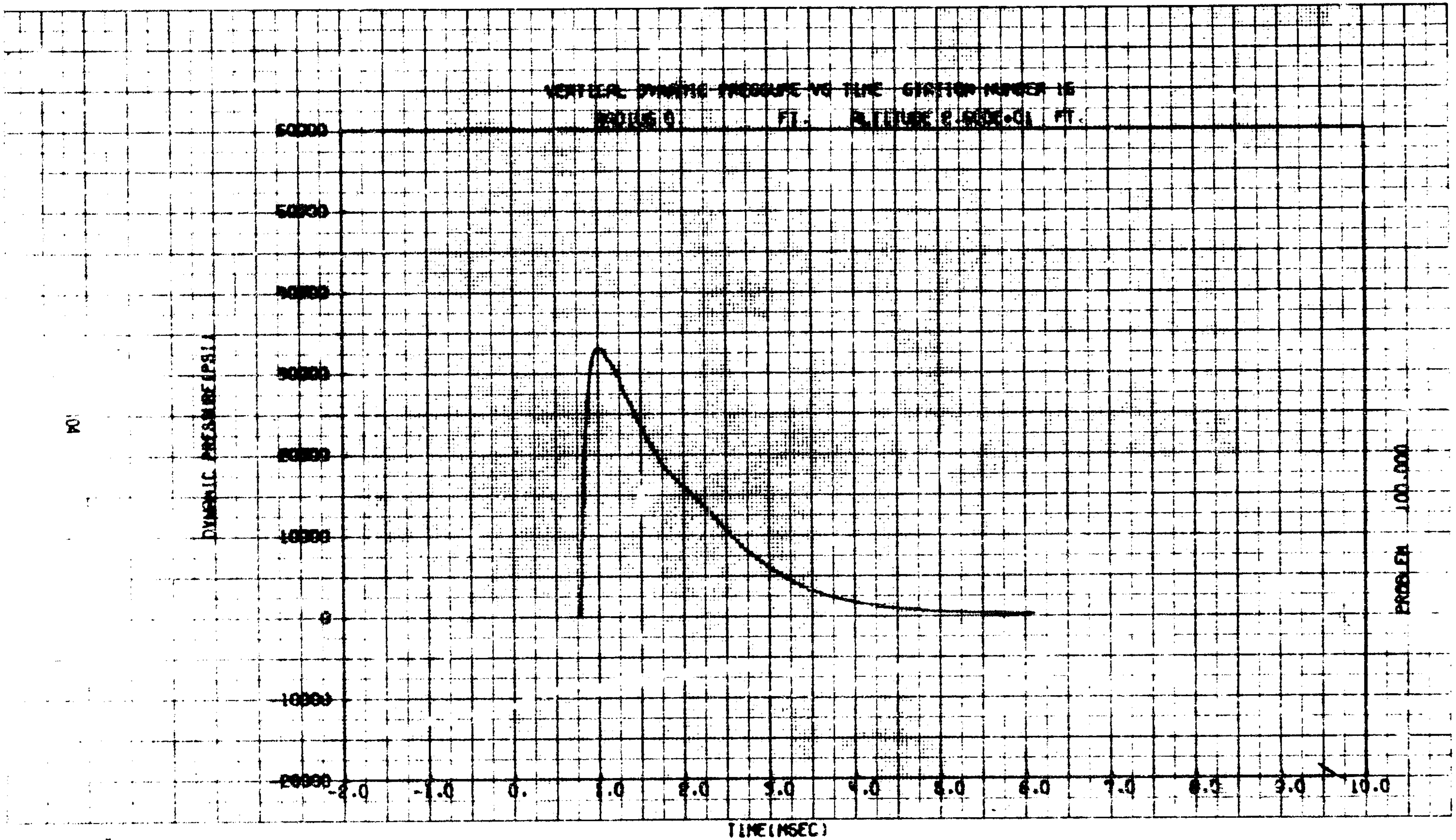
WAVE FORMS AT THE TEST STATIONS

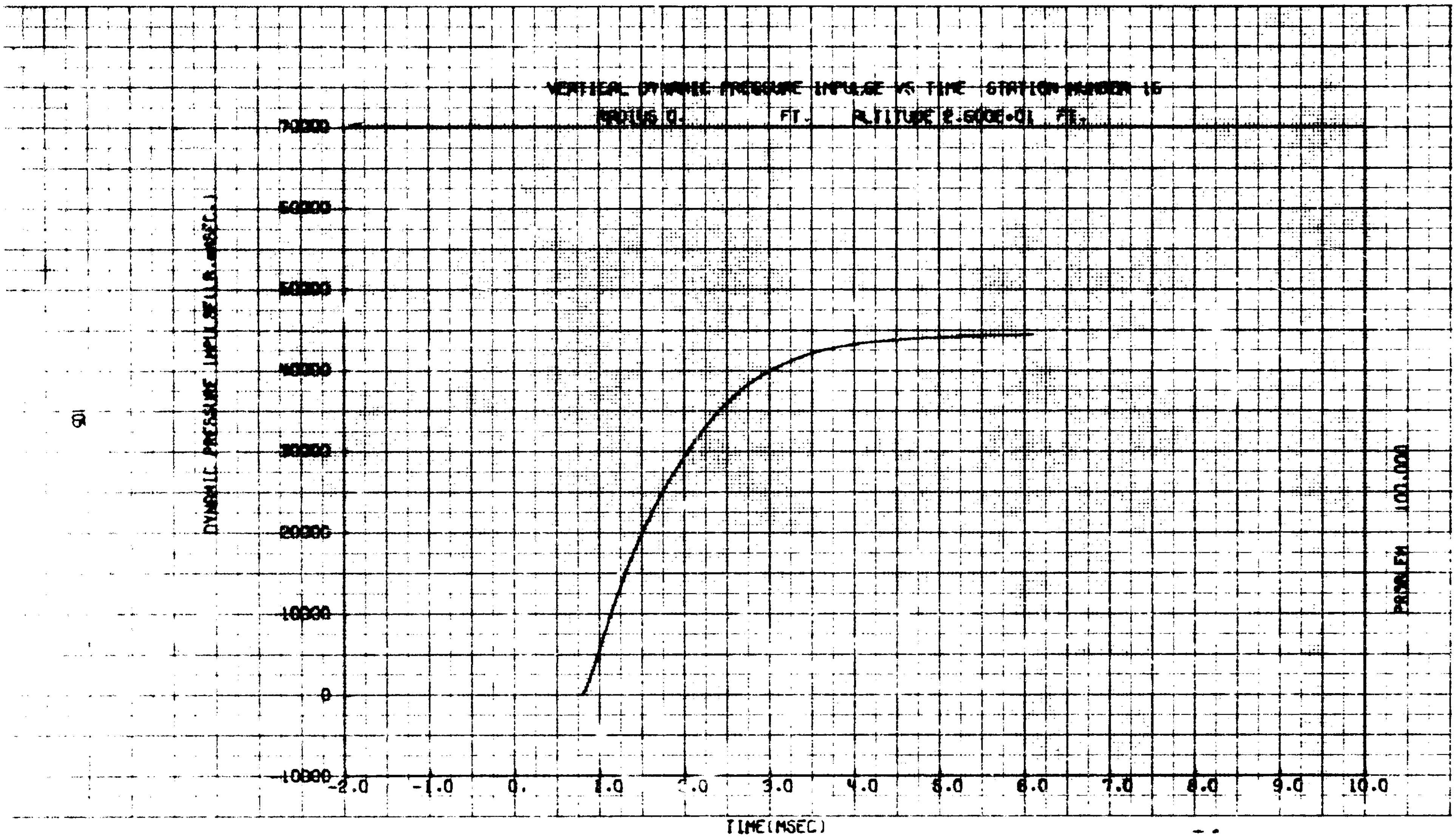
Appendix II contains the tracings recorded at each test station of overpressure, dynamic pressure, overpressure impulse, dynamic pressure impulse, and velocity. These plots are made on two different time scales, the first being terminated at the end of the positive phase and the second running from just before arrival time to 600 ms.

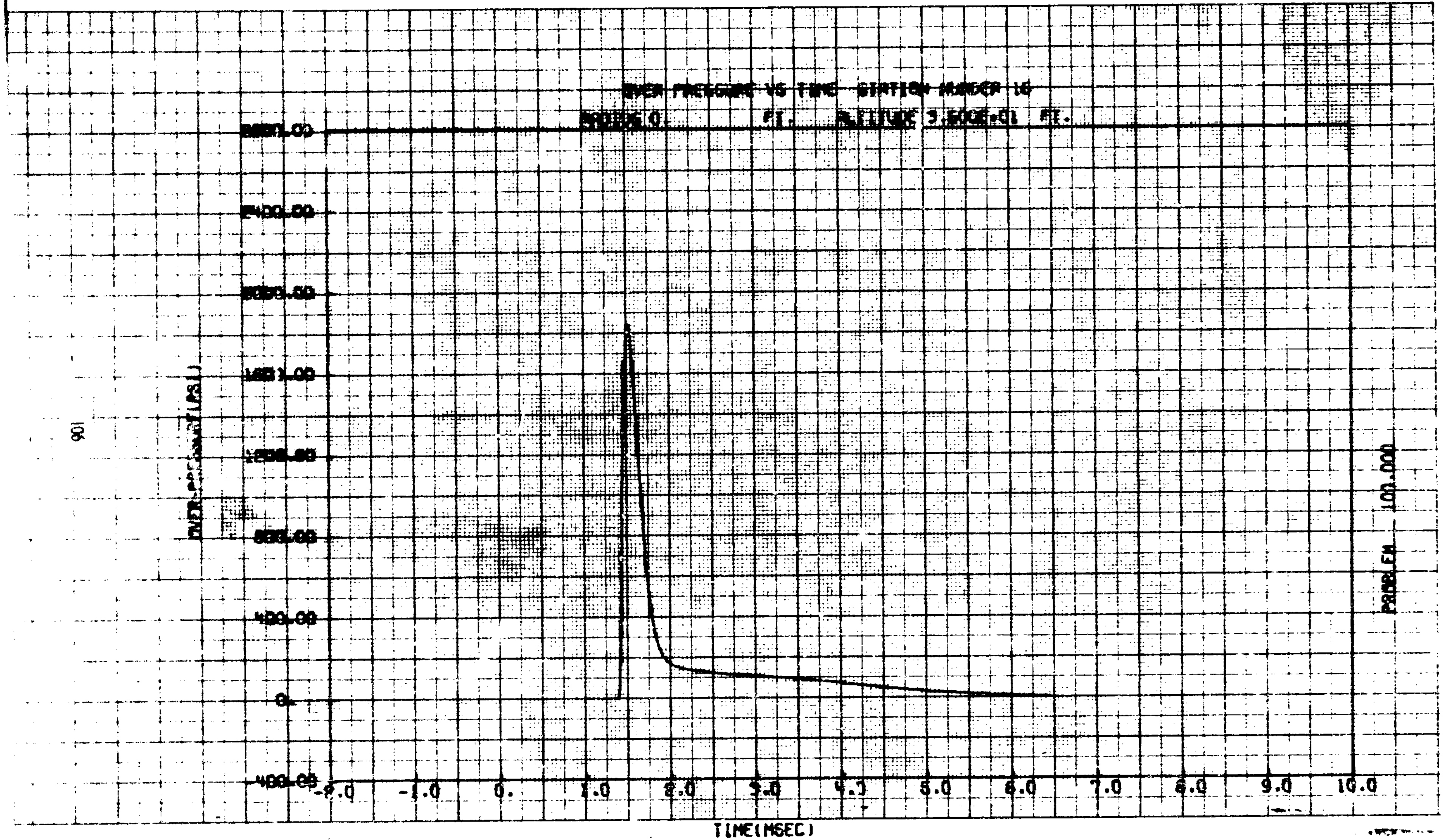

OVER-PRESSURE VS TIME STATION NUMBER 16
RADIUS(D) FT. ALTITUDE FT.
PROBLEM 100.000
TIME(MSEC)
OVER-PRESSURE(PSI)
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0.
400.00
800.00
1200.00
1600.00
2000.00
2400.00
2800.00
3200.00

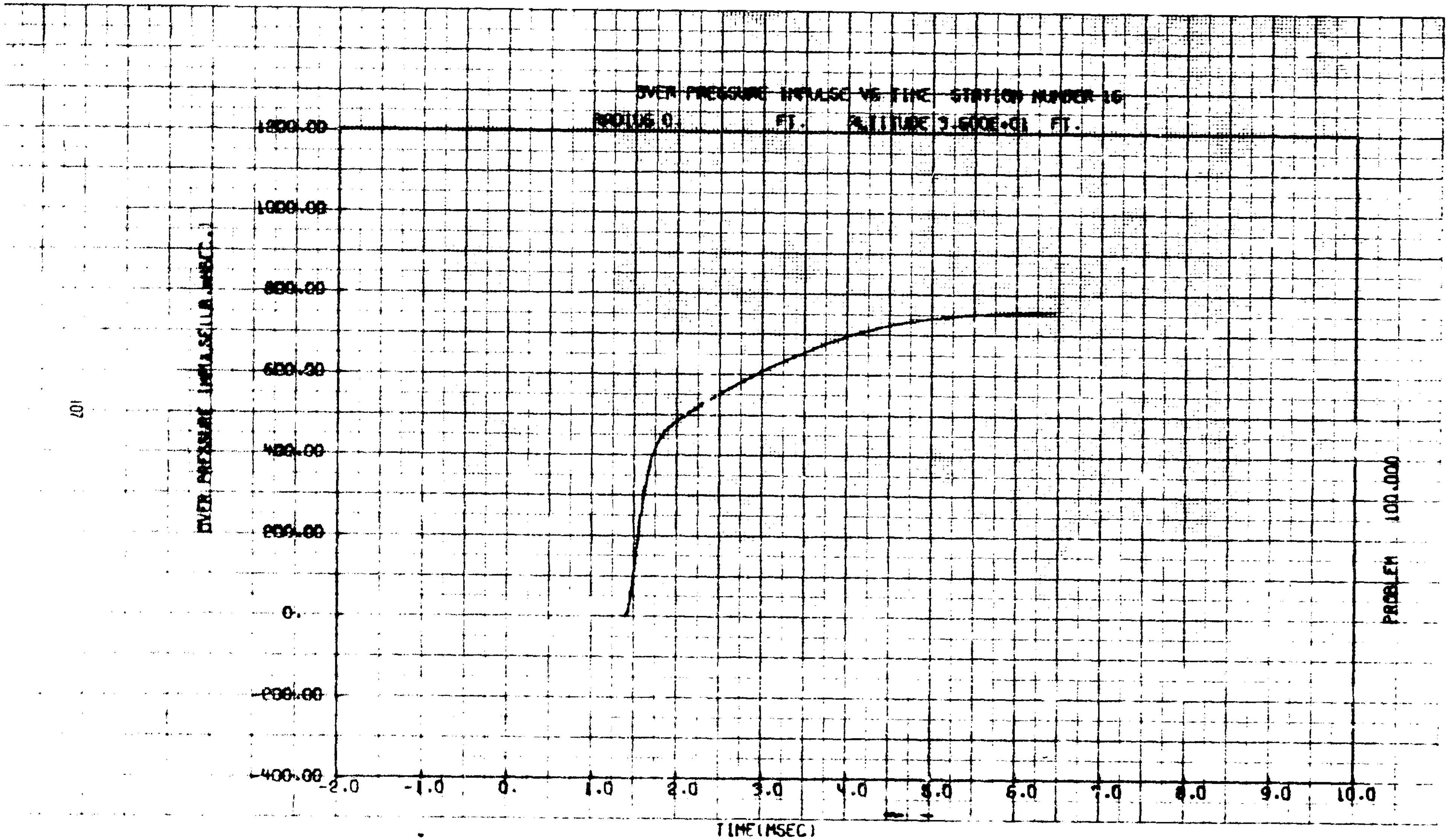

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE 2.500E+01 FT.
PROBLEM 100.000
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
OVER PRESSURE IMPULSE(LB.*MSEC.)
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)

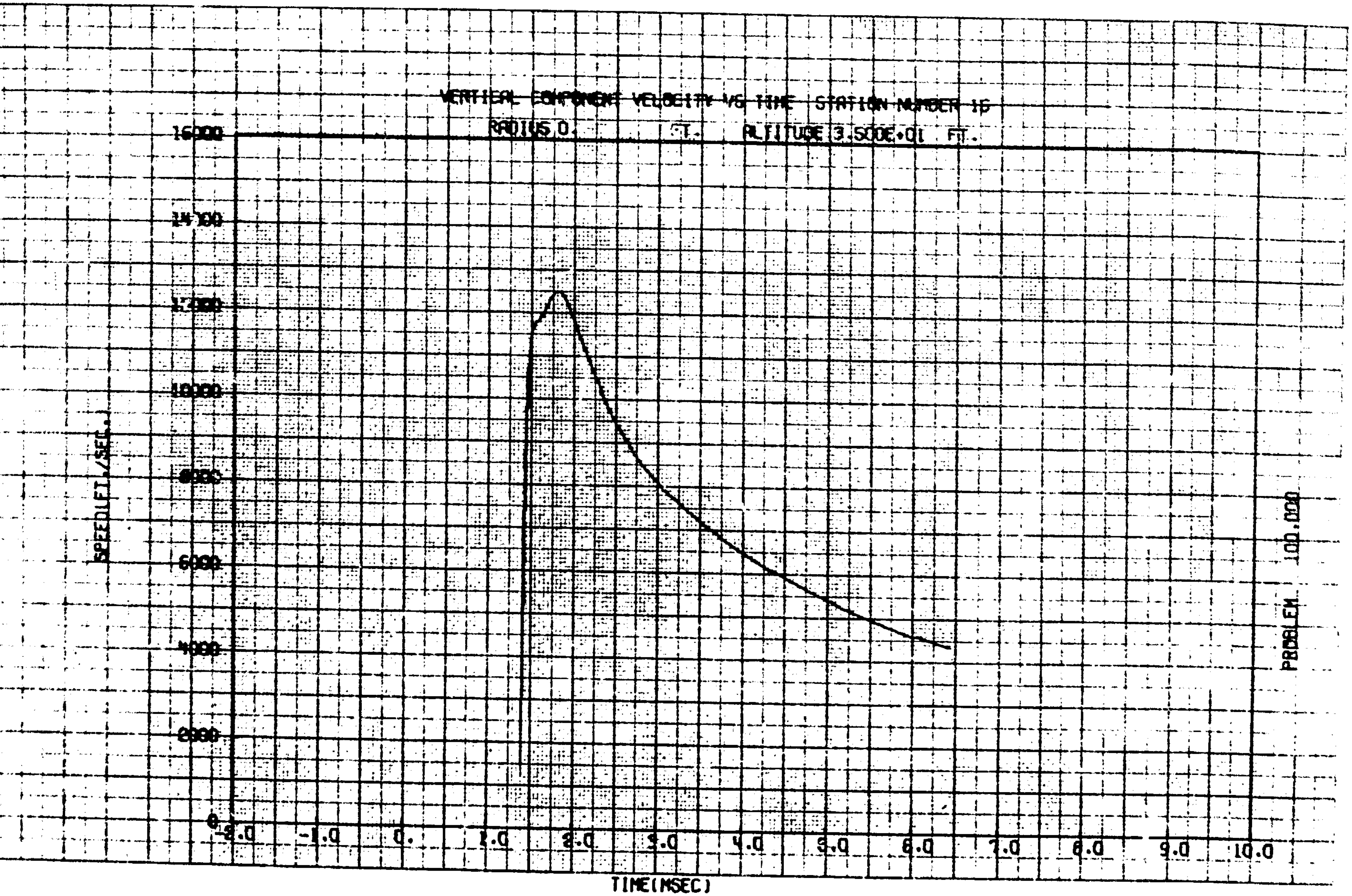

PROBLEM 100.000
STATION NUMBER 16
FT. ALTITUDE 2.500E+01 FT.
TIME(MSEC)
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
SPEED(FT./SEC.)
0
2000
4000
6000
8000
10000
12000
14000
16000

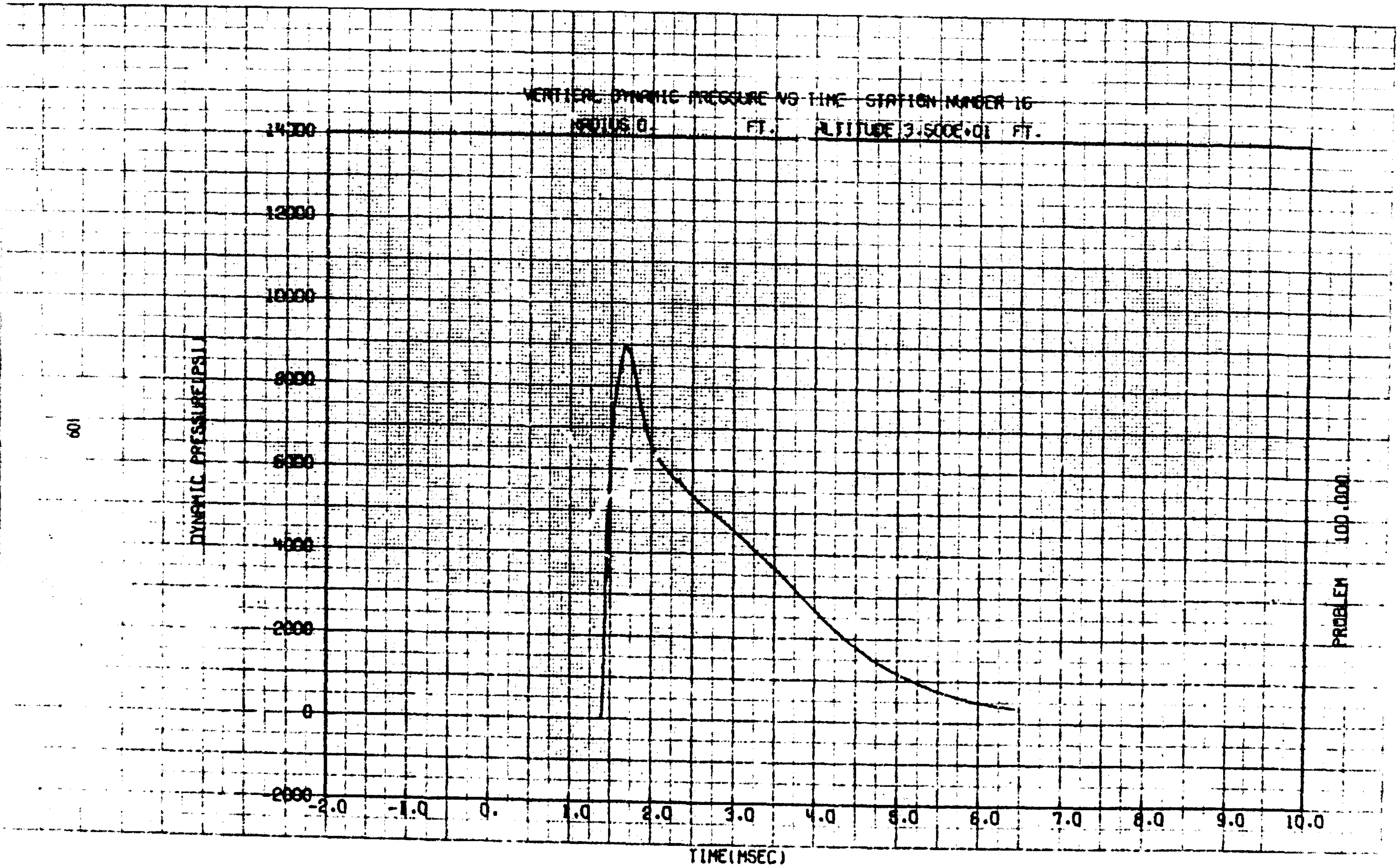

VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE FT.
DYNAMIC PRESSURE(PSI)
60000
50000
40000
30000
20000
10000
0
-10000
-20000
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

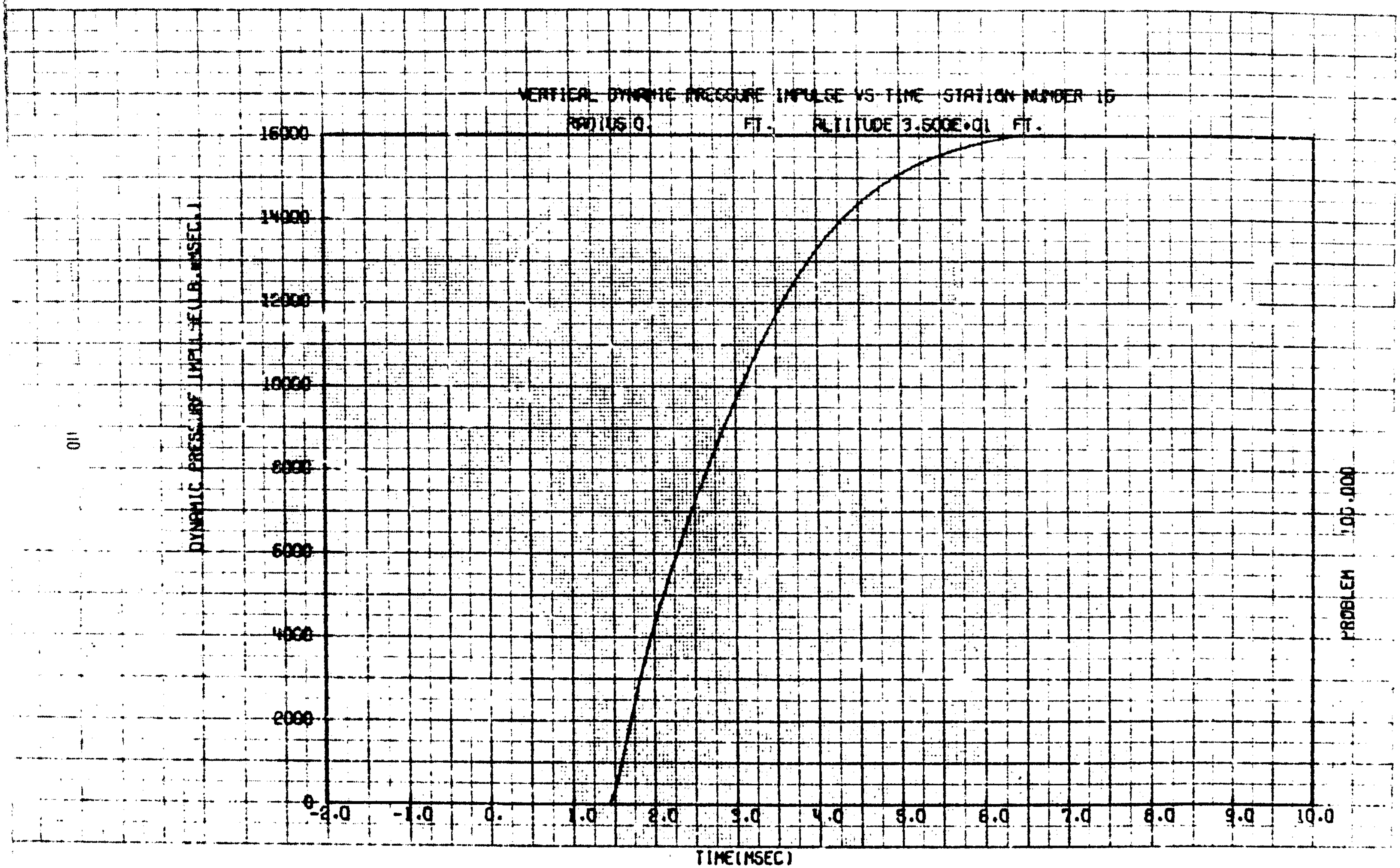

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 15
RADIUS 0. FT. ALTITUDE 2.500E+01 FT.
DYNAMIC PRESSURE IMPULSE(LB.-MSEC.)
70000
60000
50000
40000
30000
20000
10000
0
-10000
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

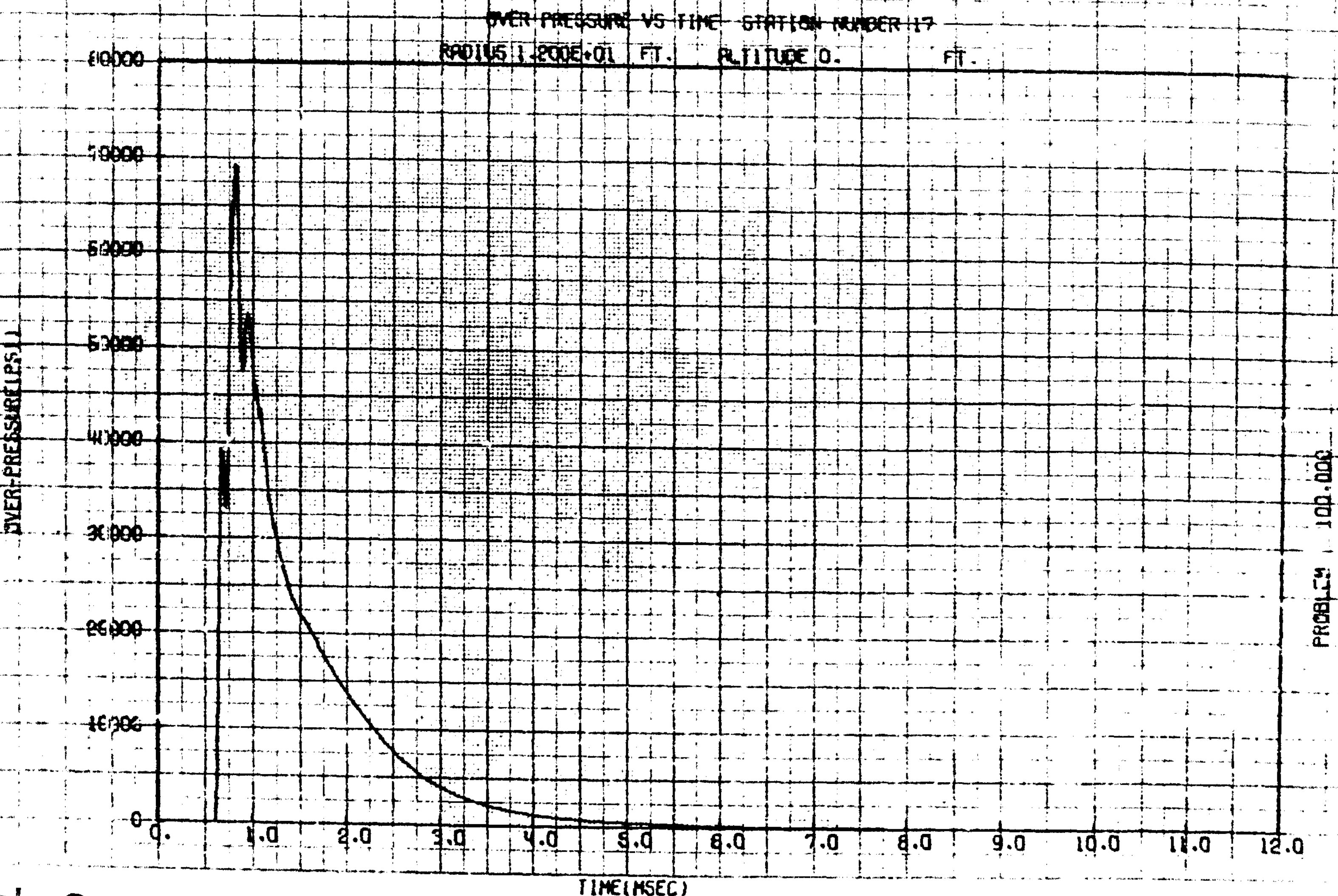

OVER PRESSURE VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE 3.500E+01 FT.
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

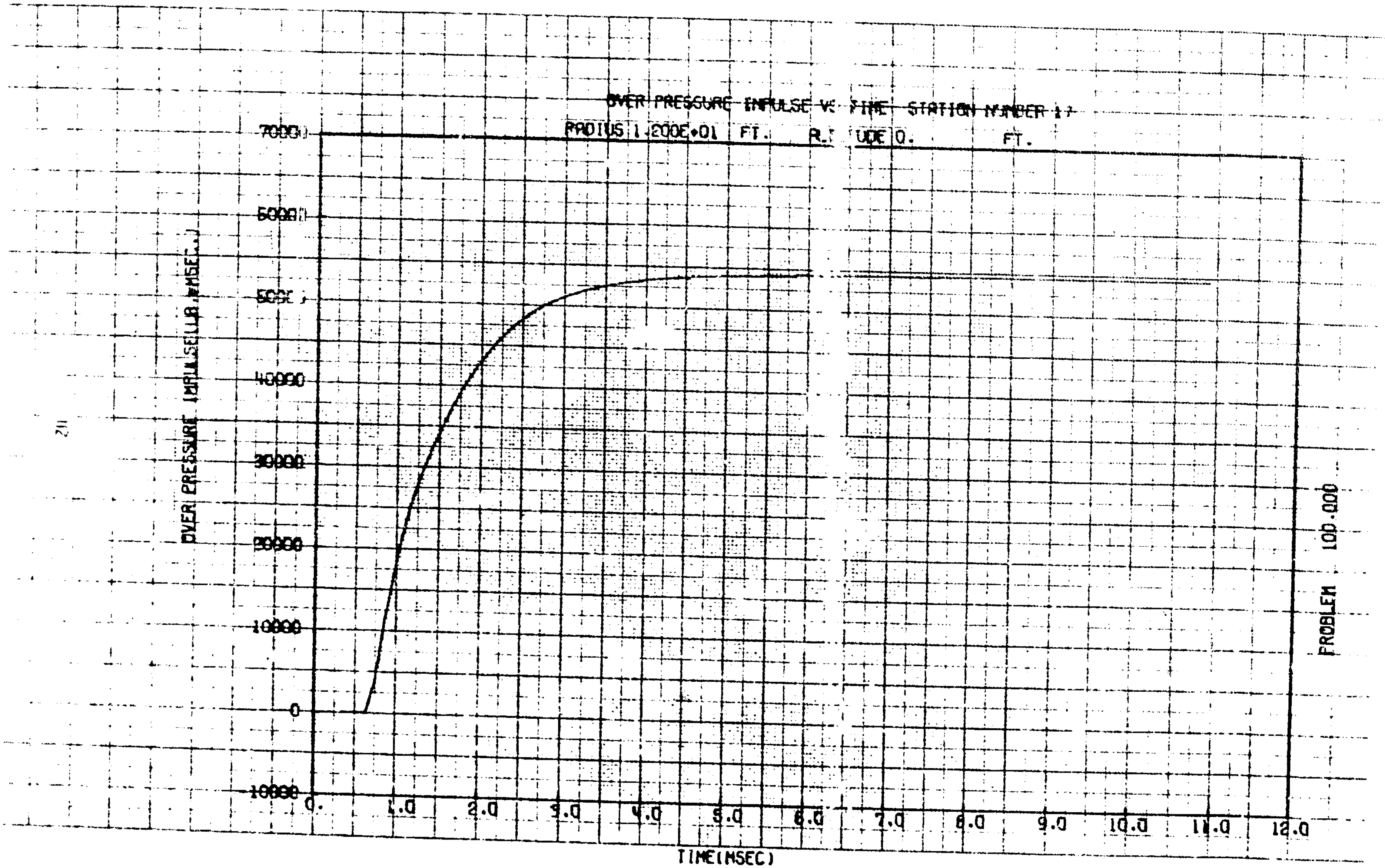

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE 3.600E+01 FT.
OVER PRESSURE IMPULSE(LB.SEC/SQ.IN.)
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-400.00
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

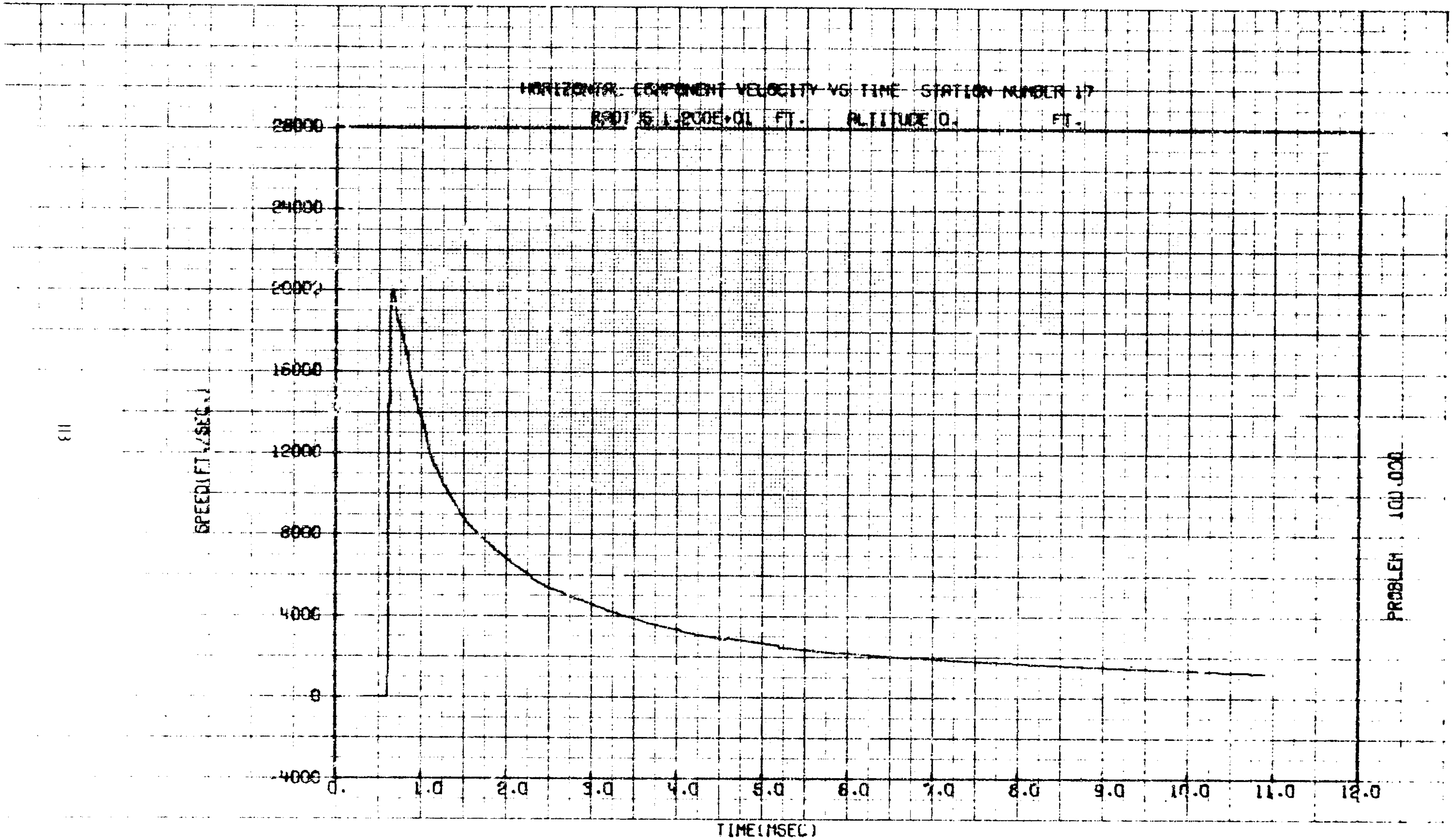

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE 3.500E+01 FT.
SPEED(FT./SEC.)
16000
14000
12000
10000
8000
6000
4000
2000
0
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000


VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 16
RADIUS 0. FT. ALTITUDE 3.500E+01 FT.
DYNAMIC PRESSURE(PSI)
14000
12000
10000
8000
6000
4000
2000
0
-2000
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

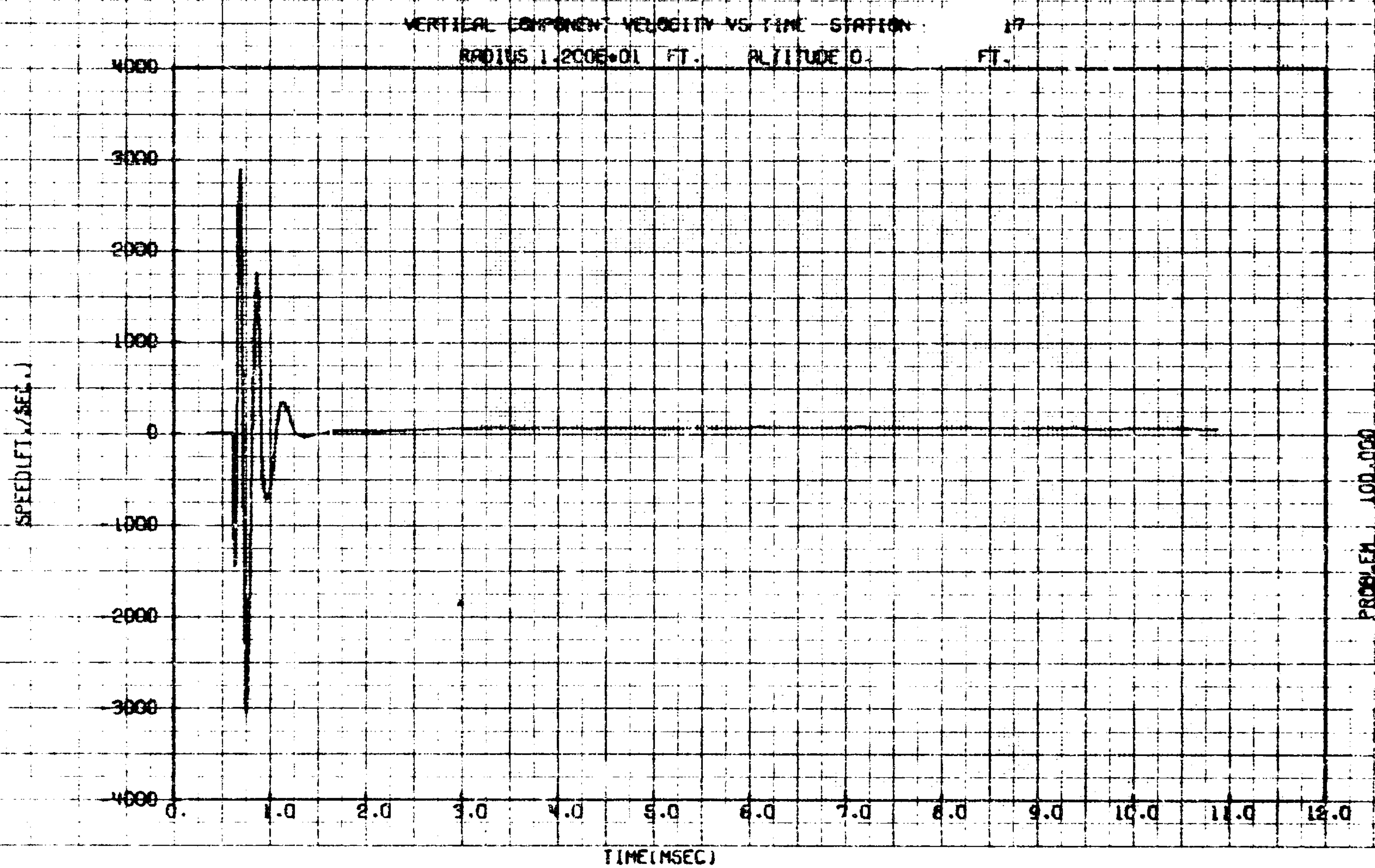

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 15
RADIUS 0. FT. ALTITUDE 3.500E+01 FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
16000
14000
12000
10000
8000
6000
4000
2000
0
-2.0
-1.0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME(MSEC)
PROBLEM 100.000

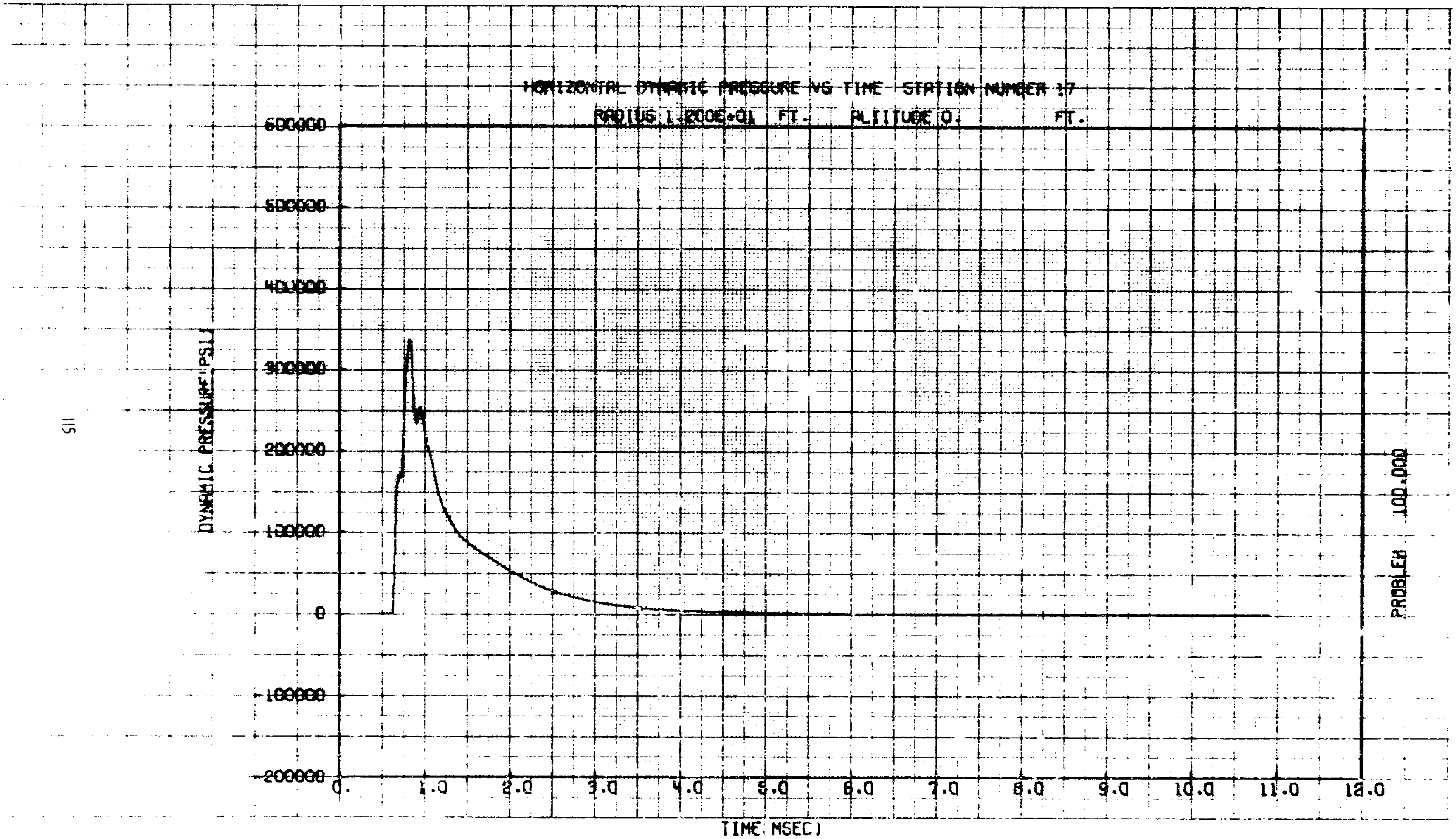

OVER PRESSURE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
TIME(MSEC)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
0
10000
20000
30000
40000
50000
60000
70000
80000
PROBLEM 100.000

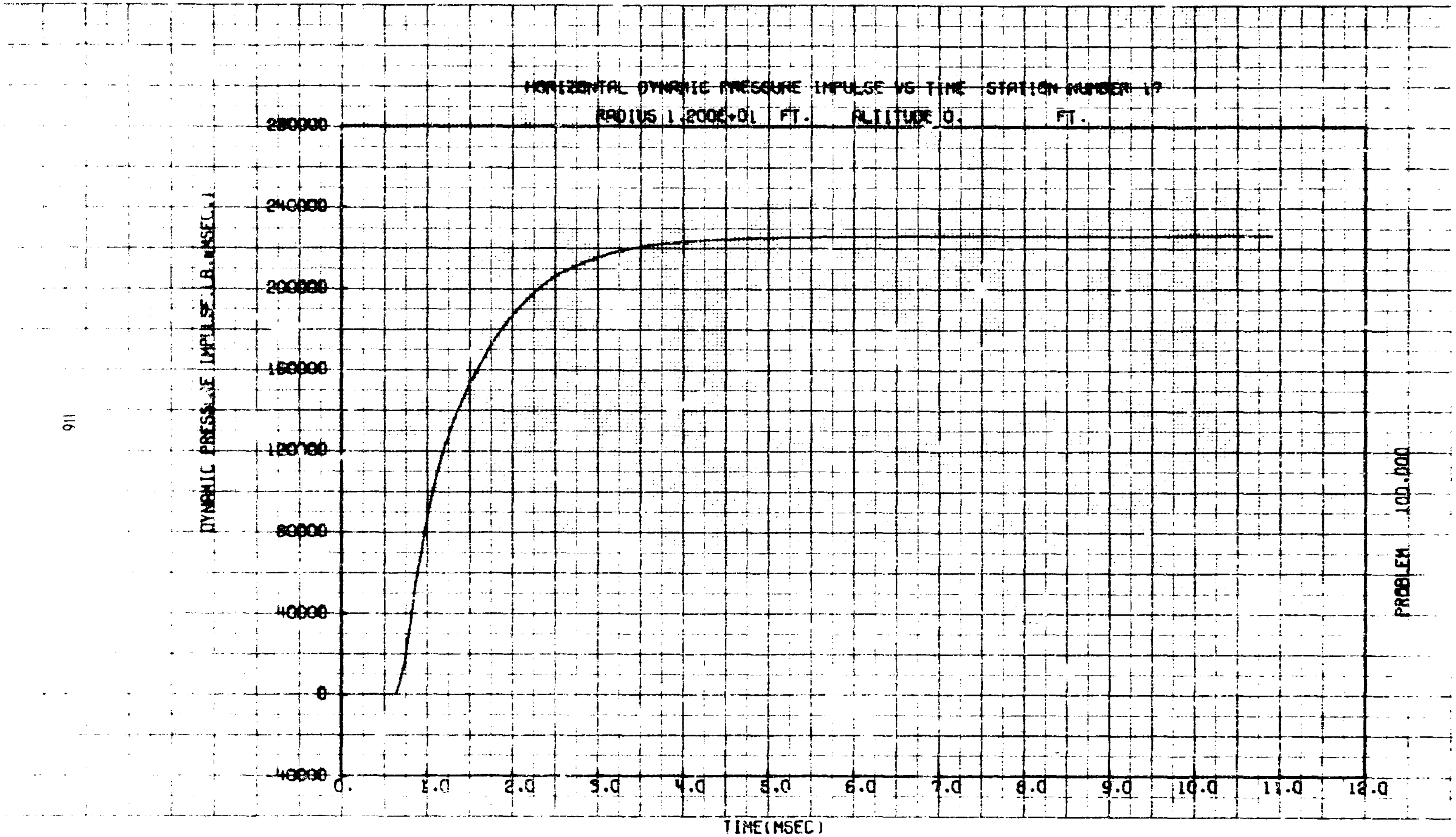

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT.
FT.
7000
5000
0
-10000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

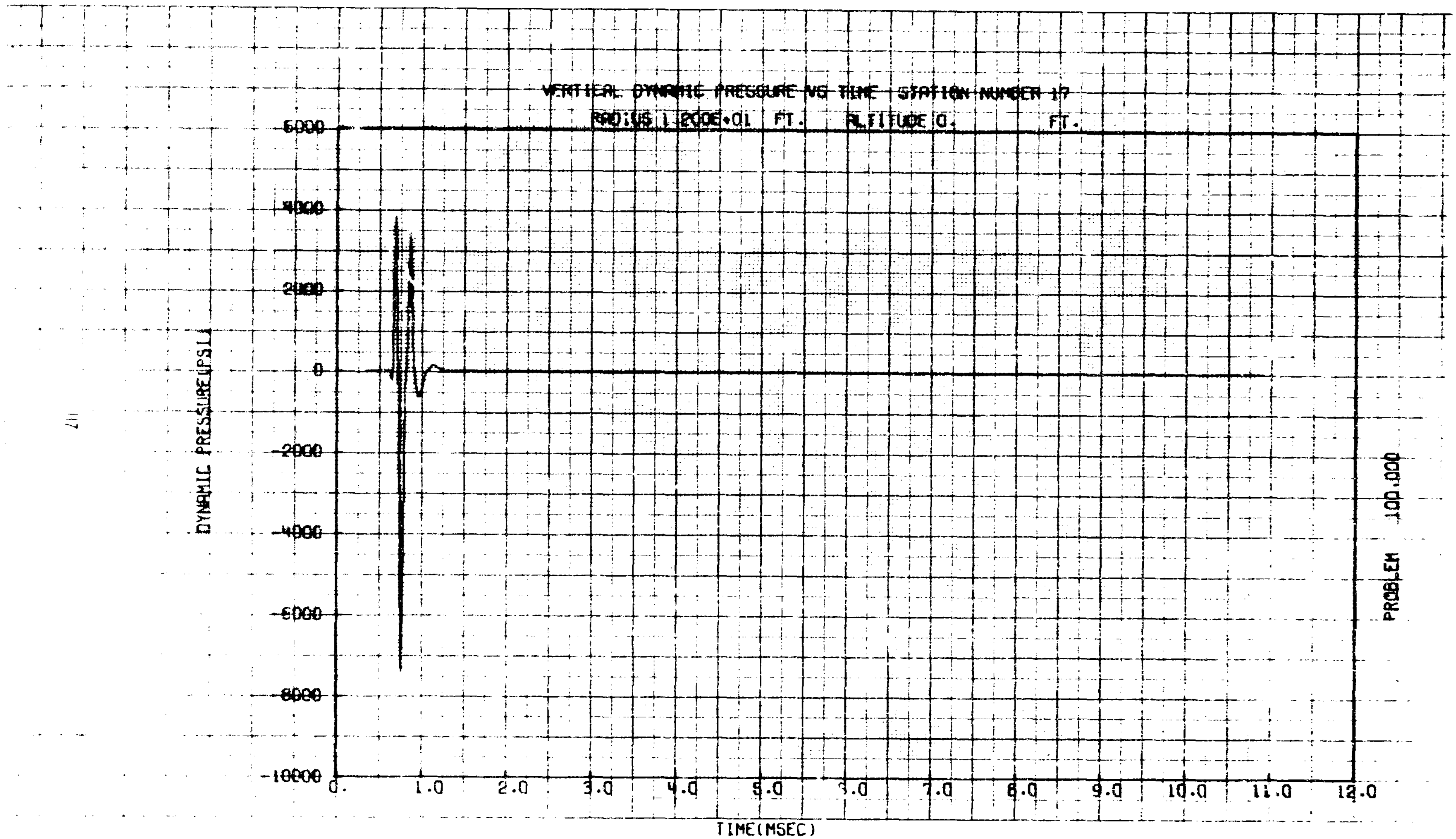


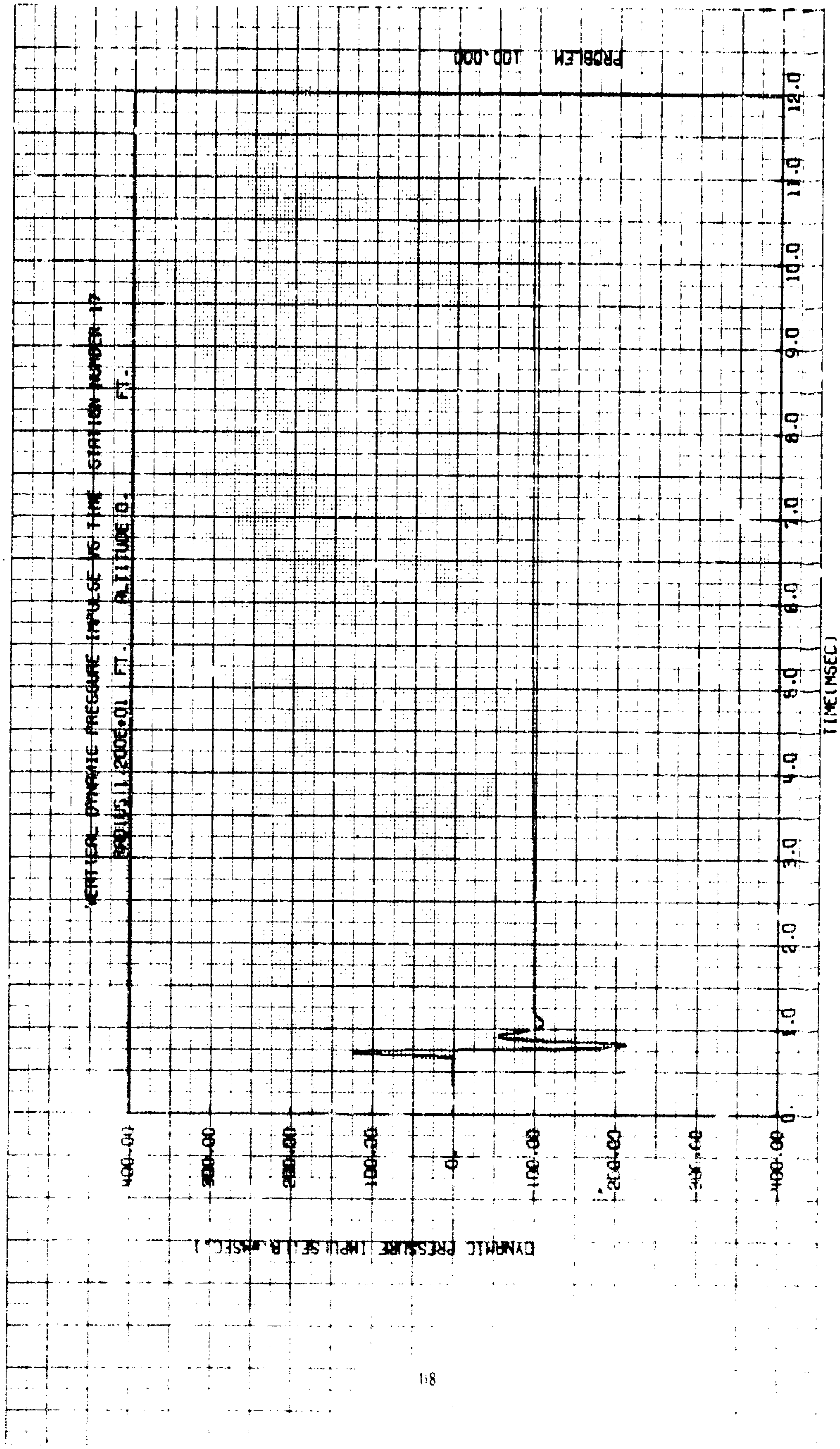
HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
28000
24000
20000
16000
12000
8000
4000
0
-4000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

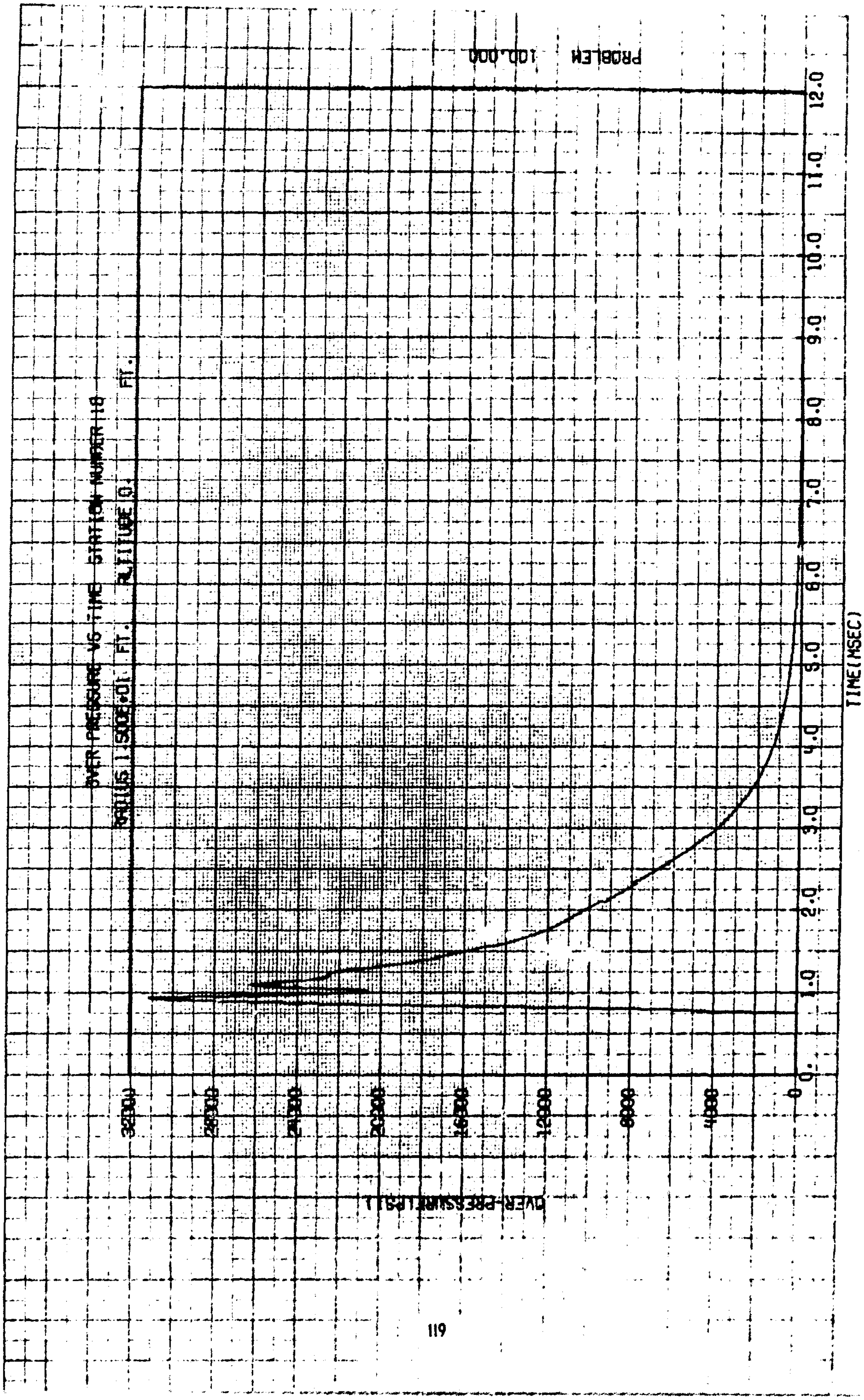

VERTICAL COMPONENT VELOCITY VS TIME STATION 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
SPEED(FT./SEC.)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

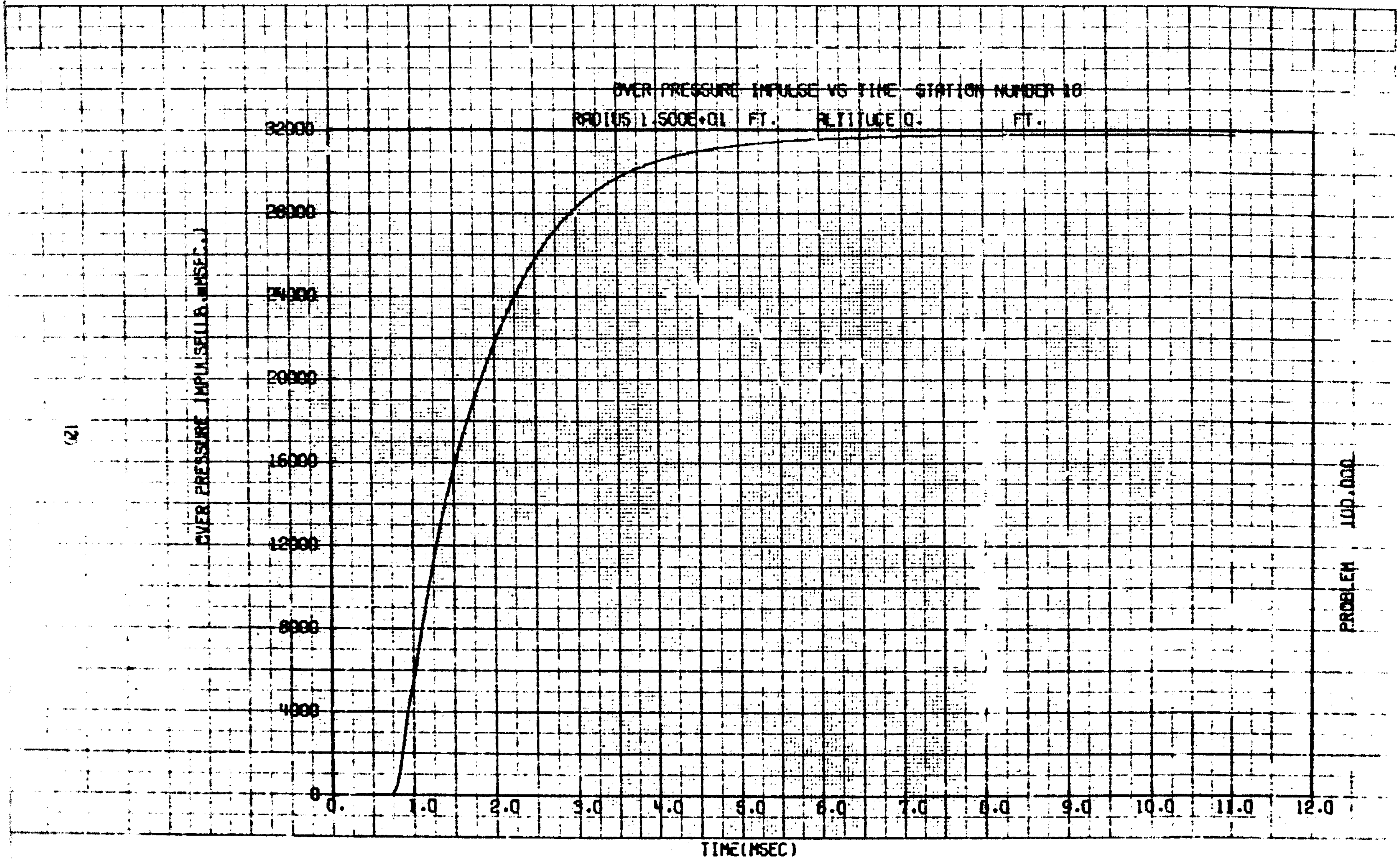

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
600000
500000
400000
300000
200000
100000
0
-100000
-200000
DYNAMIC PRESSURE(PSI)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

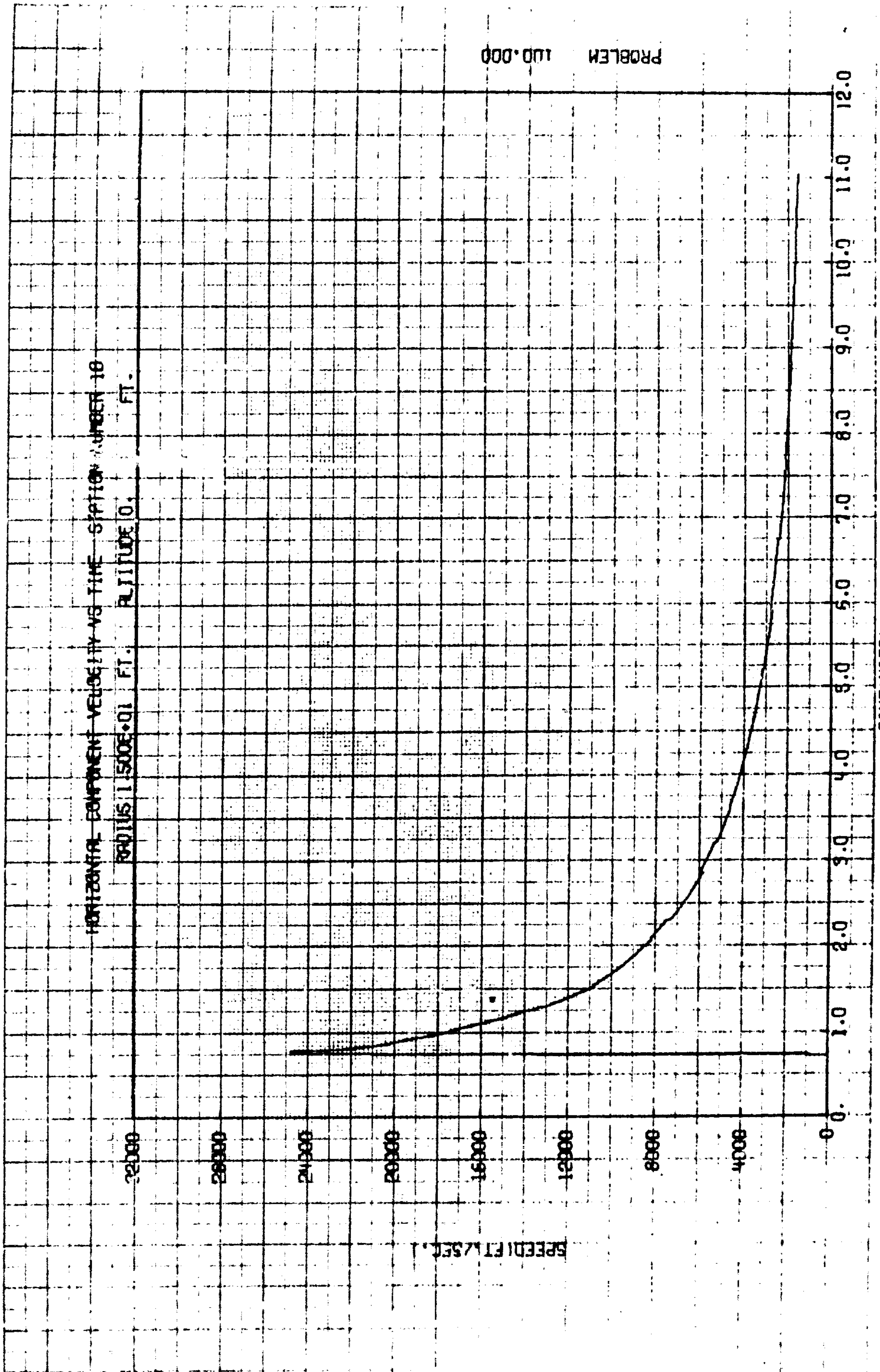

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE (LB.MSEC.)
280000
240000
200000
160000
120000
80000
40000
0
-40000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

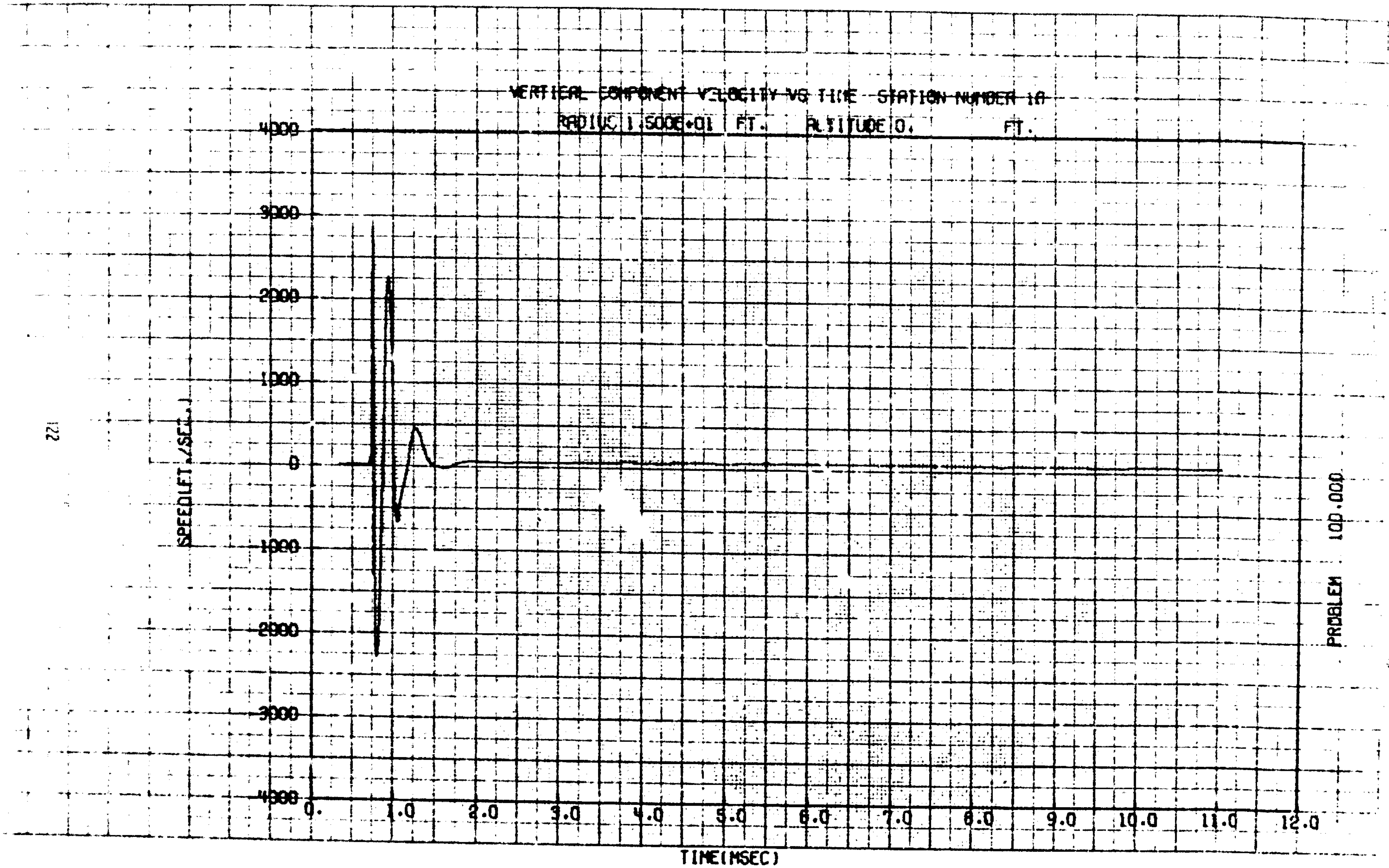

VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
6000
4000
2000
0
-2000
-4000
-6000
-8000
-10000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000


VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
0. 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
DYNAMIC PRESSURE IMPULSE(LB-MSEC.)
400.00 300.00 200.00 100.00 0 -100.00 -200.00 -300.00 -400.00

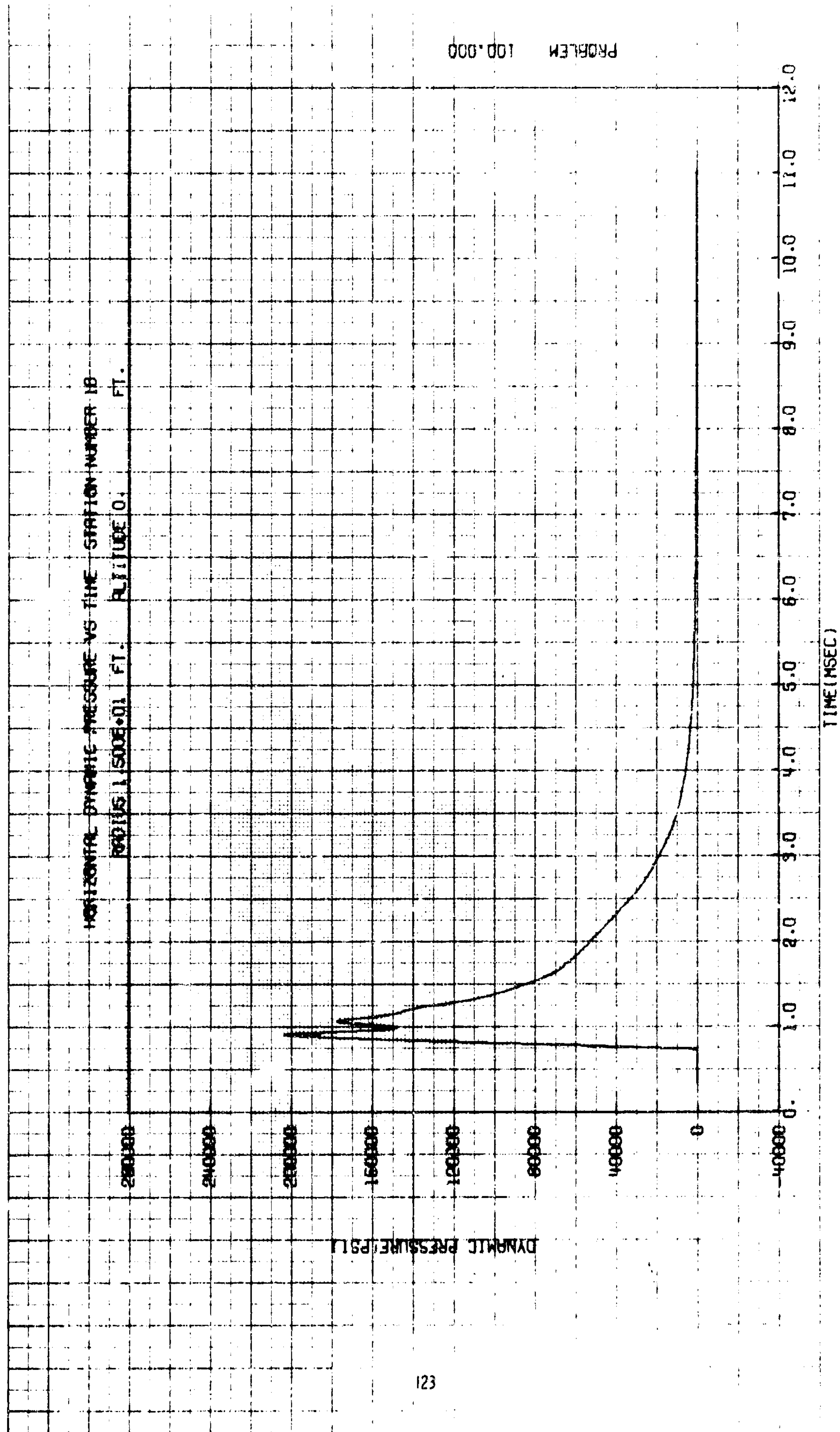

OVER-PRESSURE VS TIME STATION NUMBER 18
RADIUS 1.500E-01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
OVER-PRESSURE(PSI)
0. 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
0 4000 8000 12000 16000 20000 24000 28000 32000

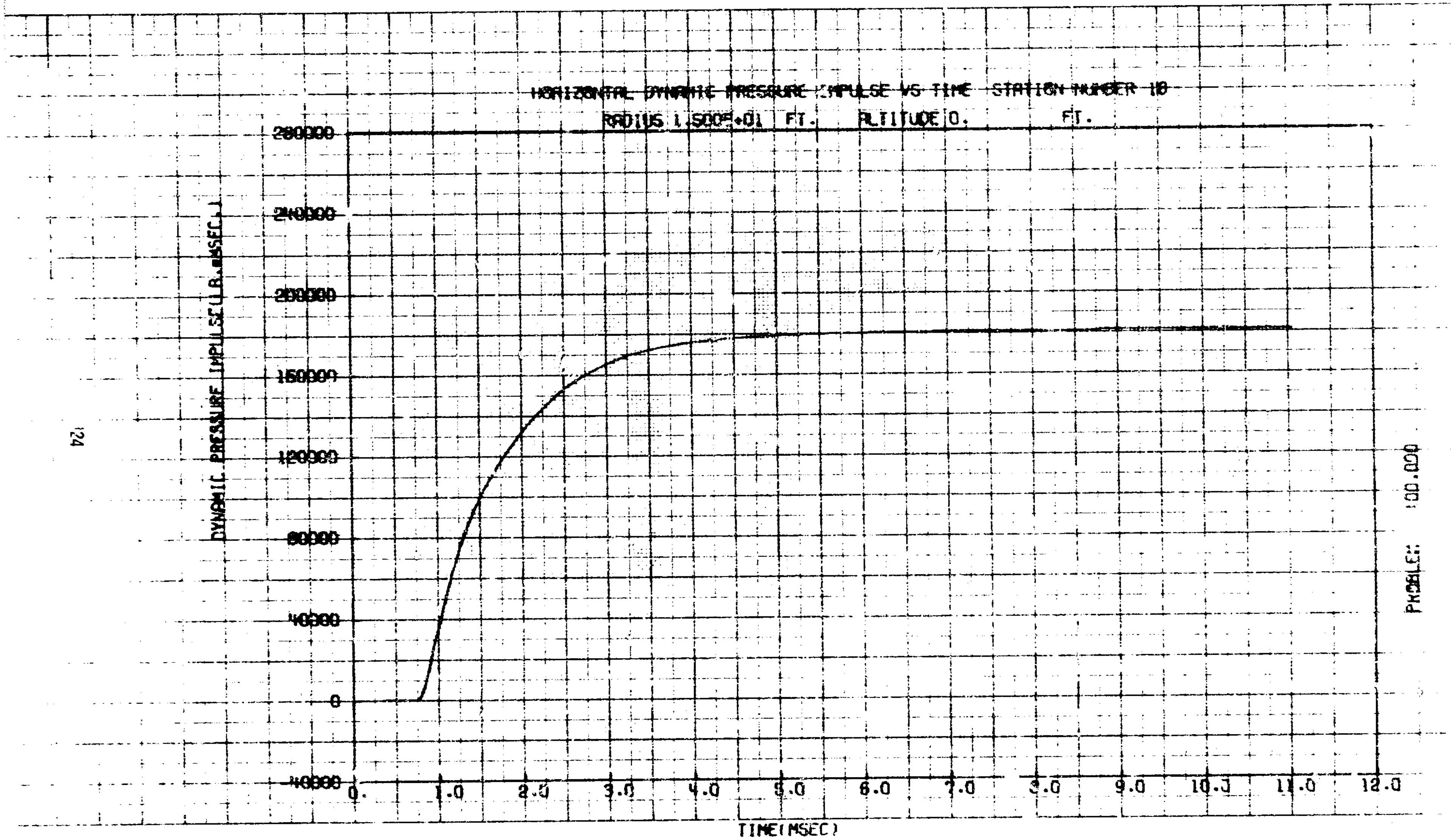

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 10
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.-MSEC.)
32000
28000
24000
20000
16000
12000
8000
4000
0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

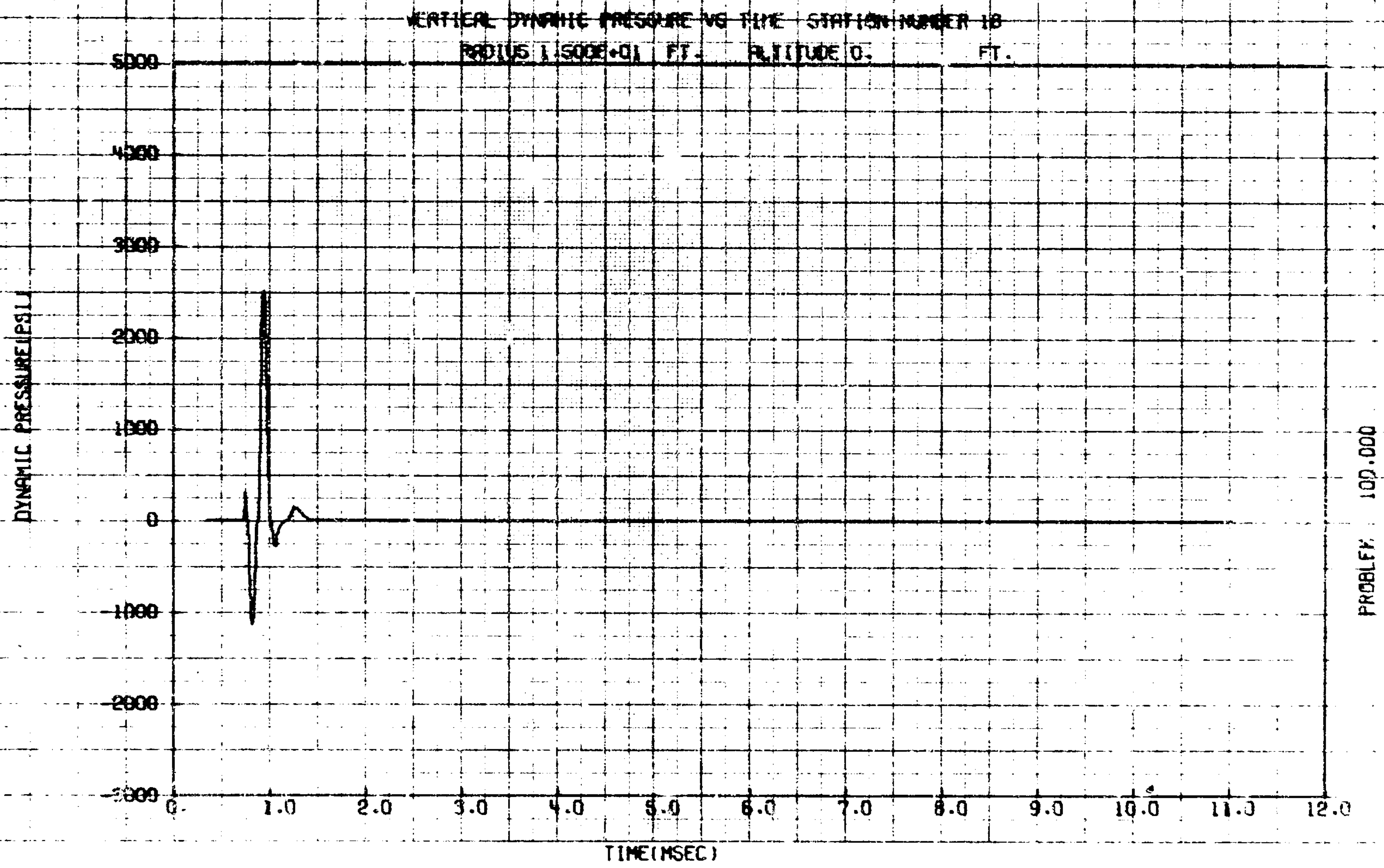

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 18
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
SPEED(FT/SEC.)
32000
28000
24000
20000
16000
12000
8000
4000
0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)

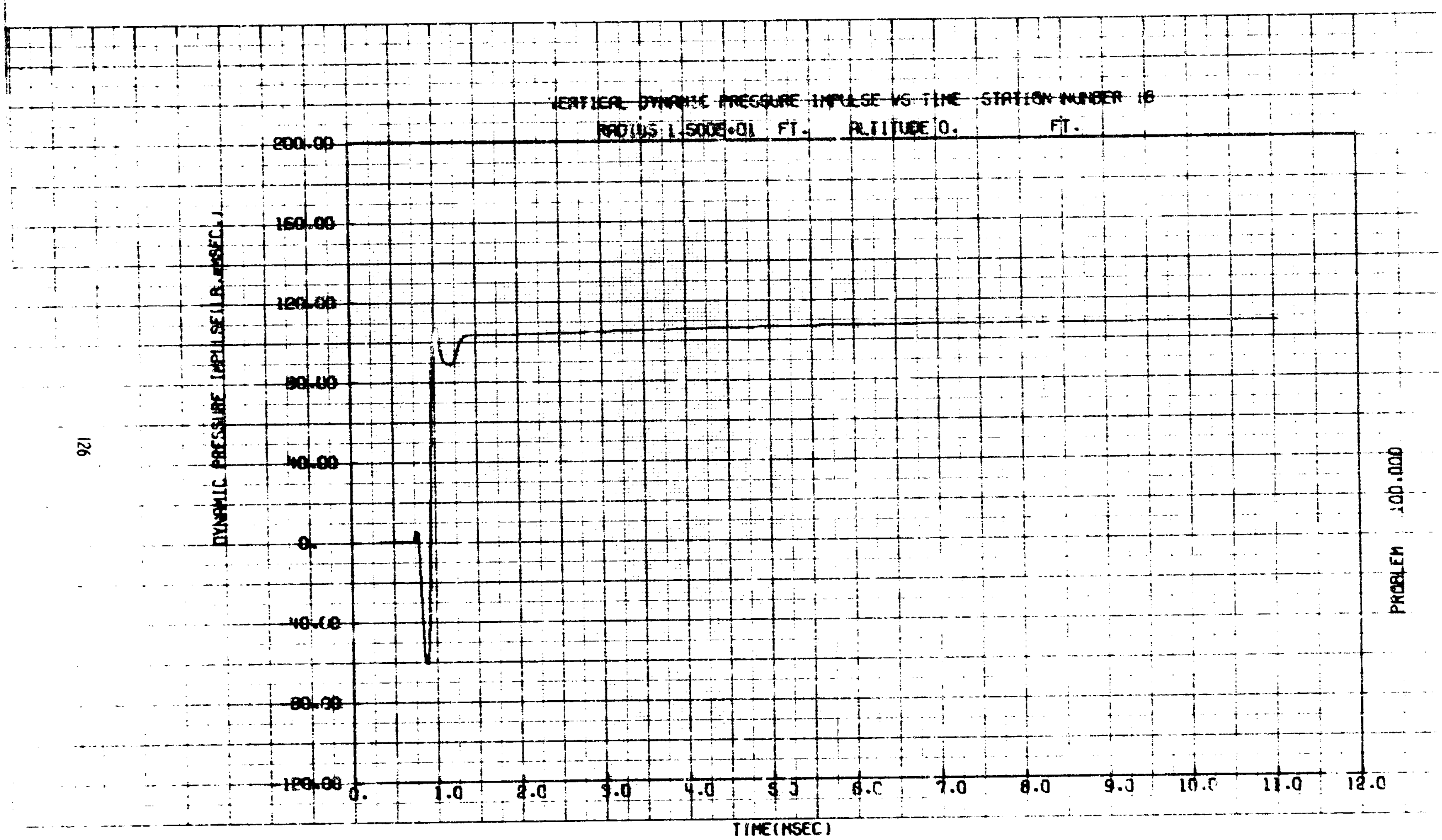


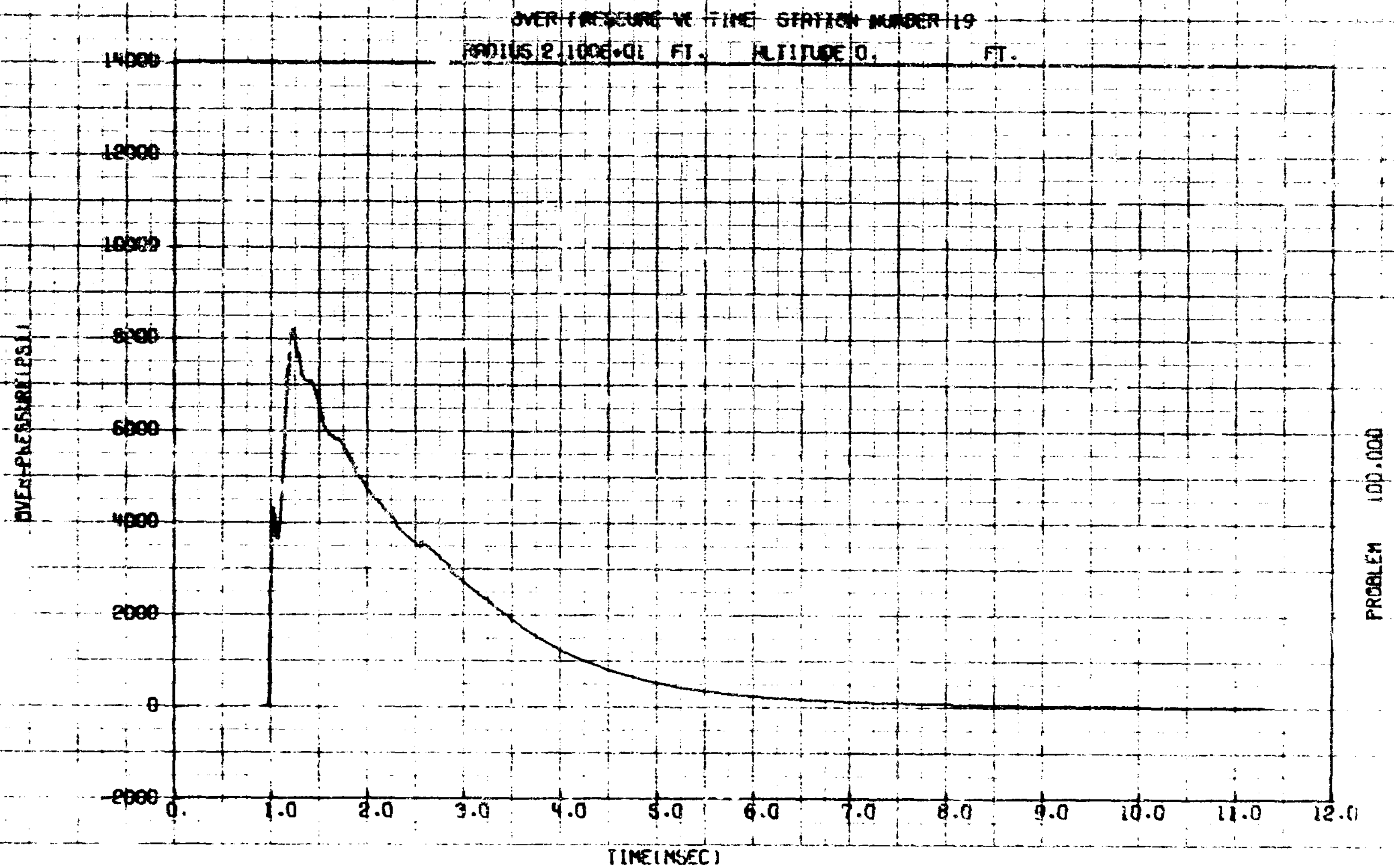
VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 1A
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
SPEED(FT./SEC.)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

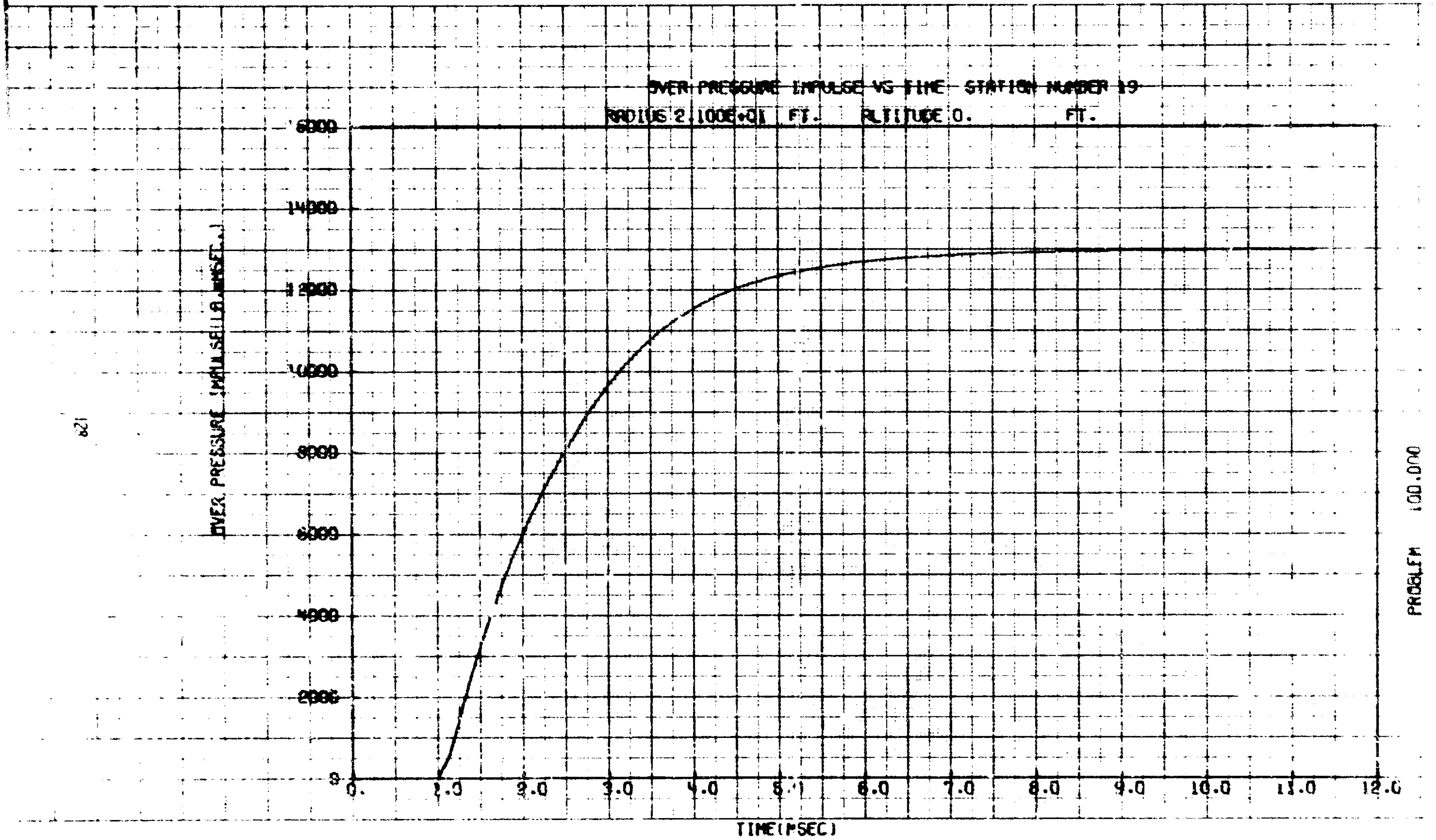

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 18
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
0. 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
DYNAMIC PRESSURE(PSI)
-40000 0 40000 80000 120000 160000 200000 240000 280000

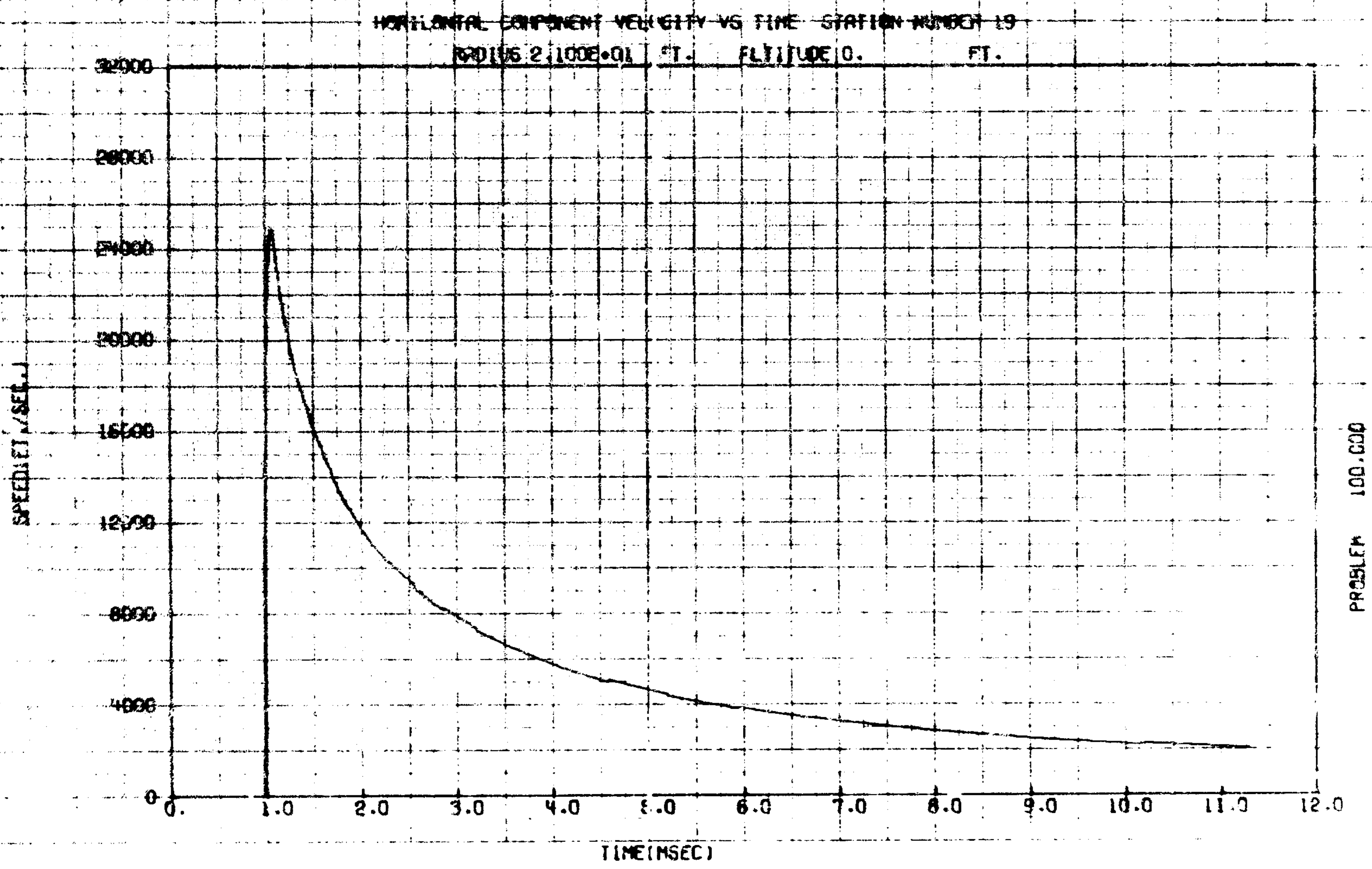

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 10
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
280000
240000
200000
160000
120000
80000
40000
0
-40000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM: 100.000

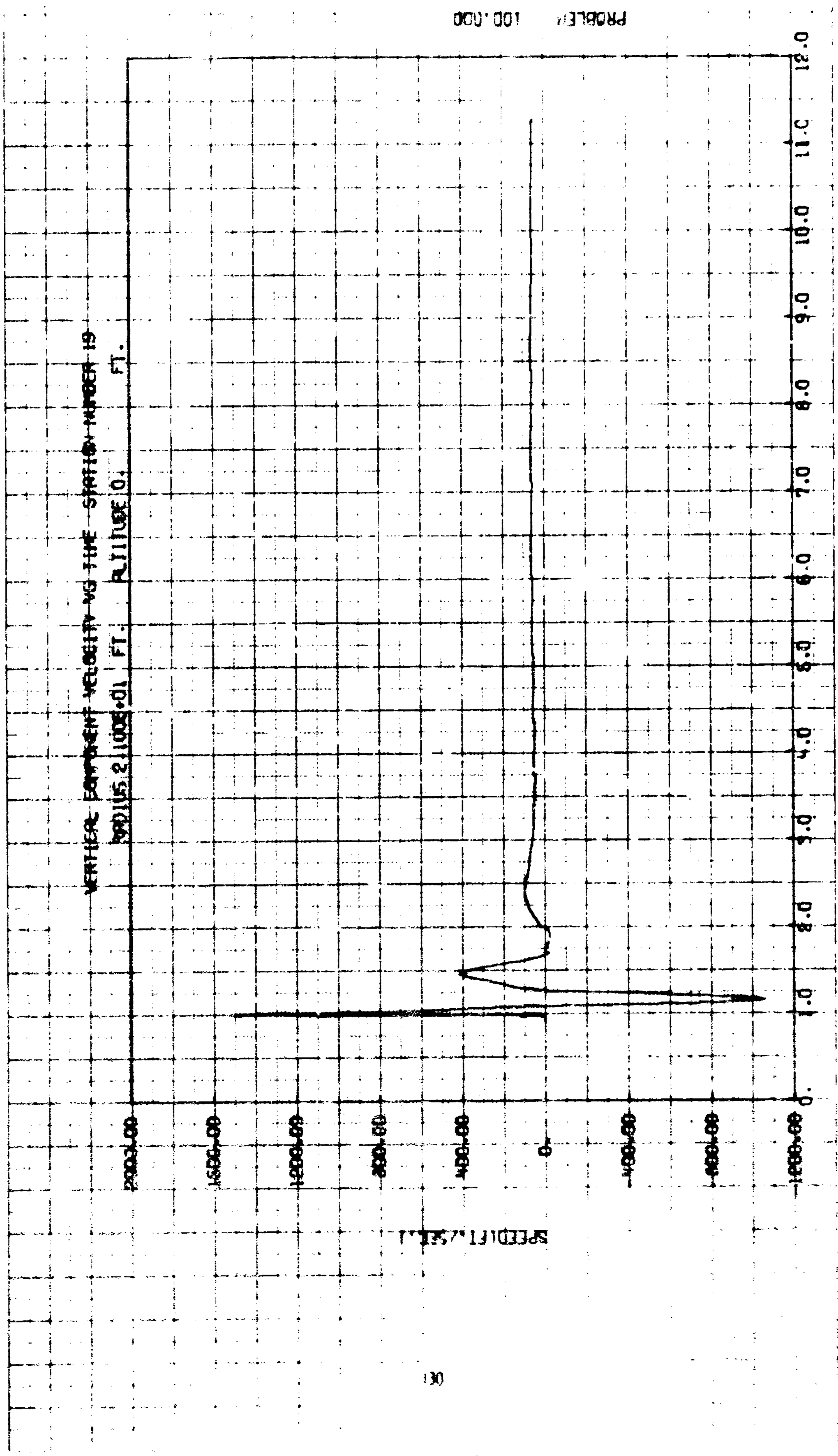

VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 18
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

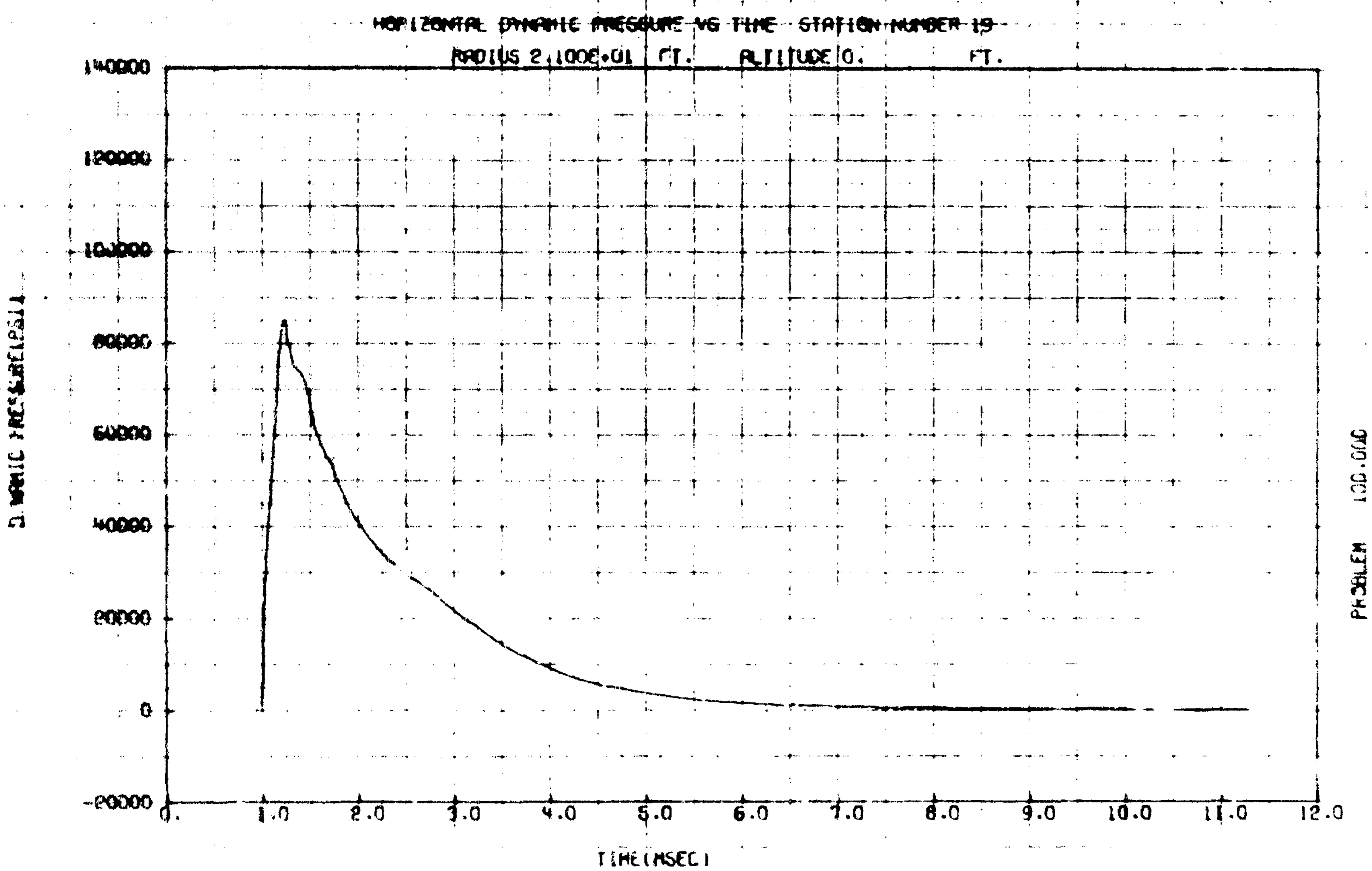

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 18
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
200.00
160.00
120.00
80.00
40.00
0.
-40.00
-80.00
-120.00
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

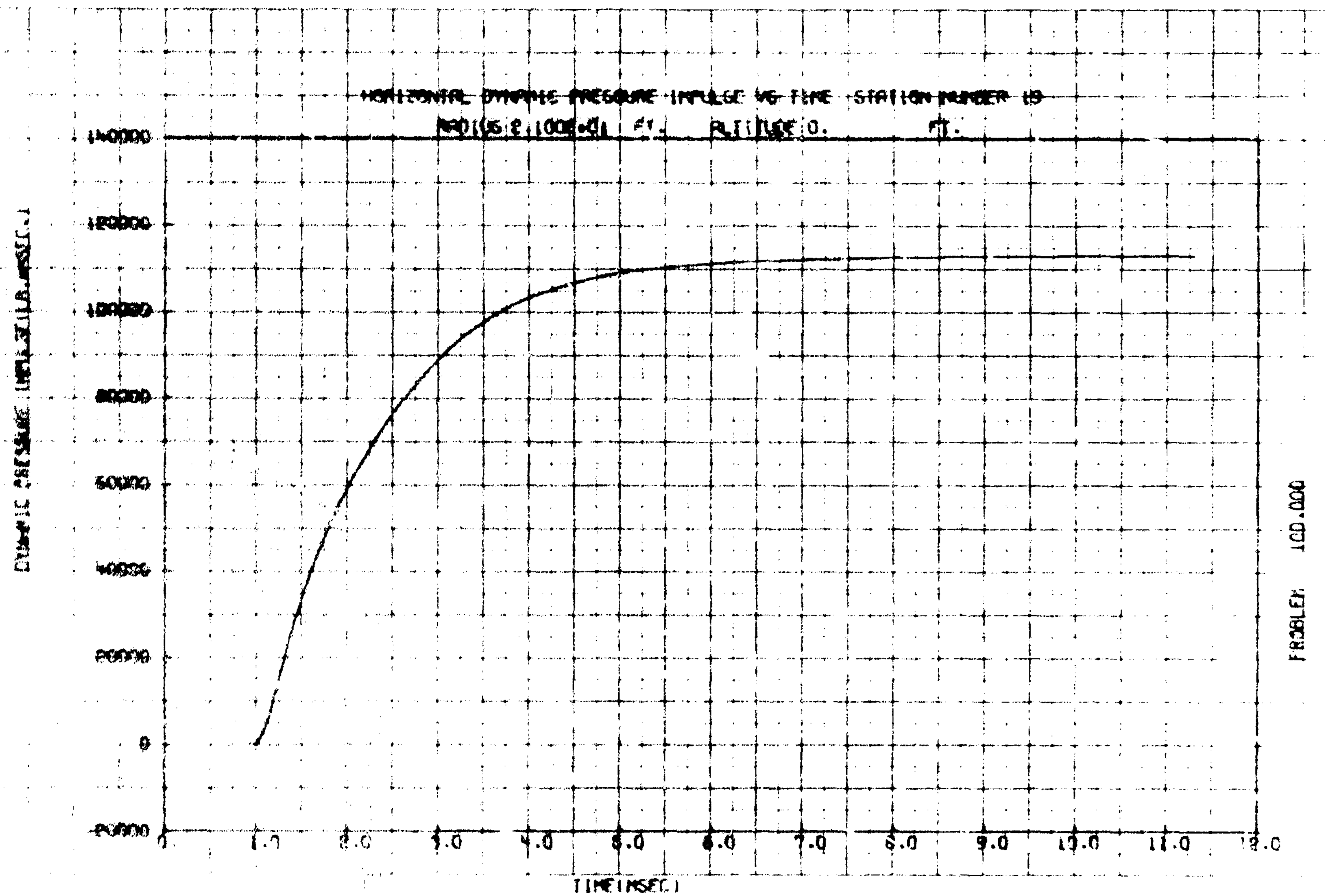

OVER PRESSURE VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
14000
12000
10000
8000
6000
4000
2000
0
-2000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

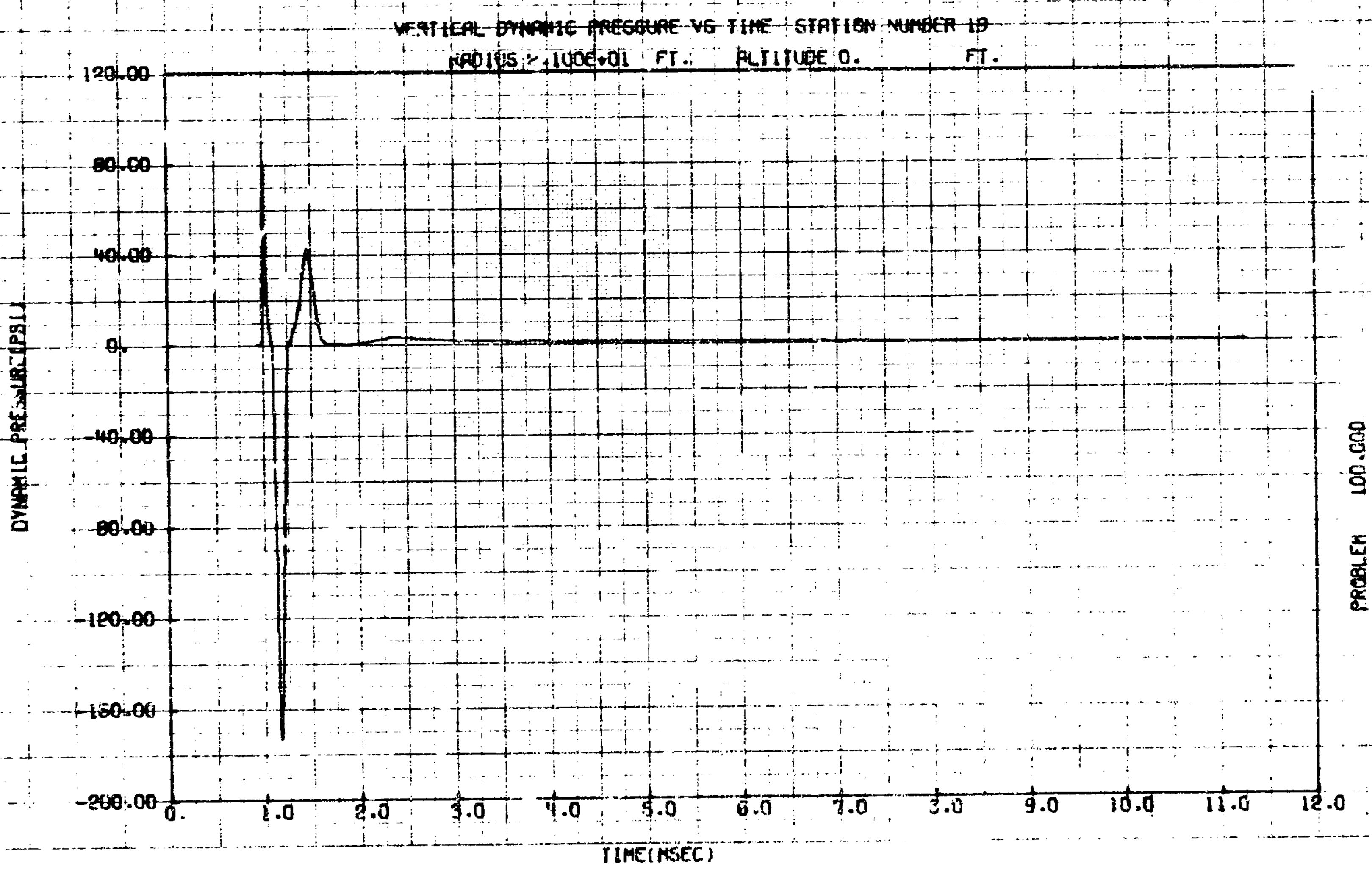

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT.   ALTITUDE 0.   FT.
OVER PRESSURE IMPULSE(LB.MSEC.)
16000
14000
12000
10000
8000
6000
4000
2000
0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000


HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
32000
28000
24000
20000
16000
12000
8000
4000
0
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

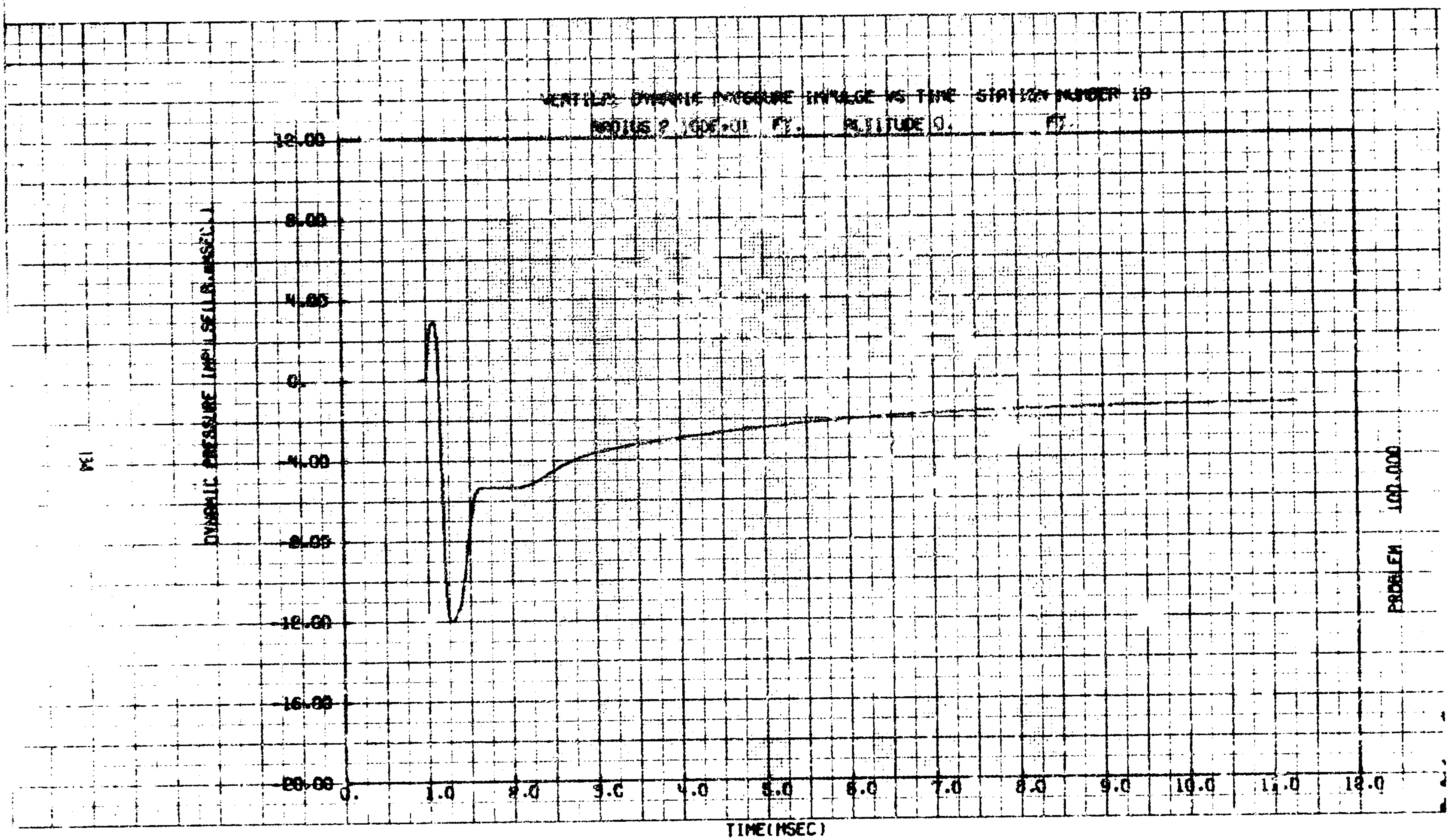

PROBLEM 100.000
VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
2000.00
1600.00
1200.00
800.00
400.00
0
-400.00
-800.00
-1200.00
TIME(MSEC)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
12.0


HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
140000
120000
100000
80000
60000
40000
20000
0
-20000
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

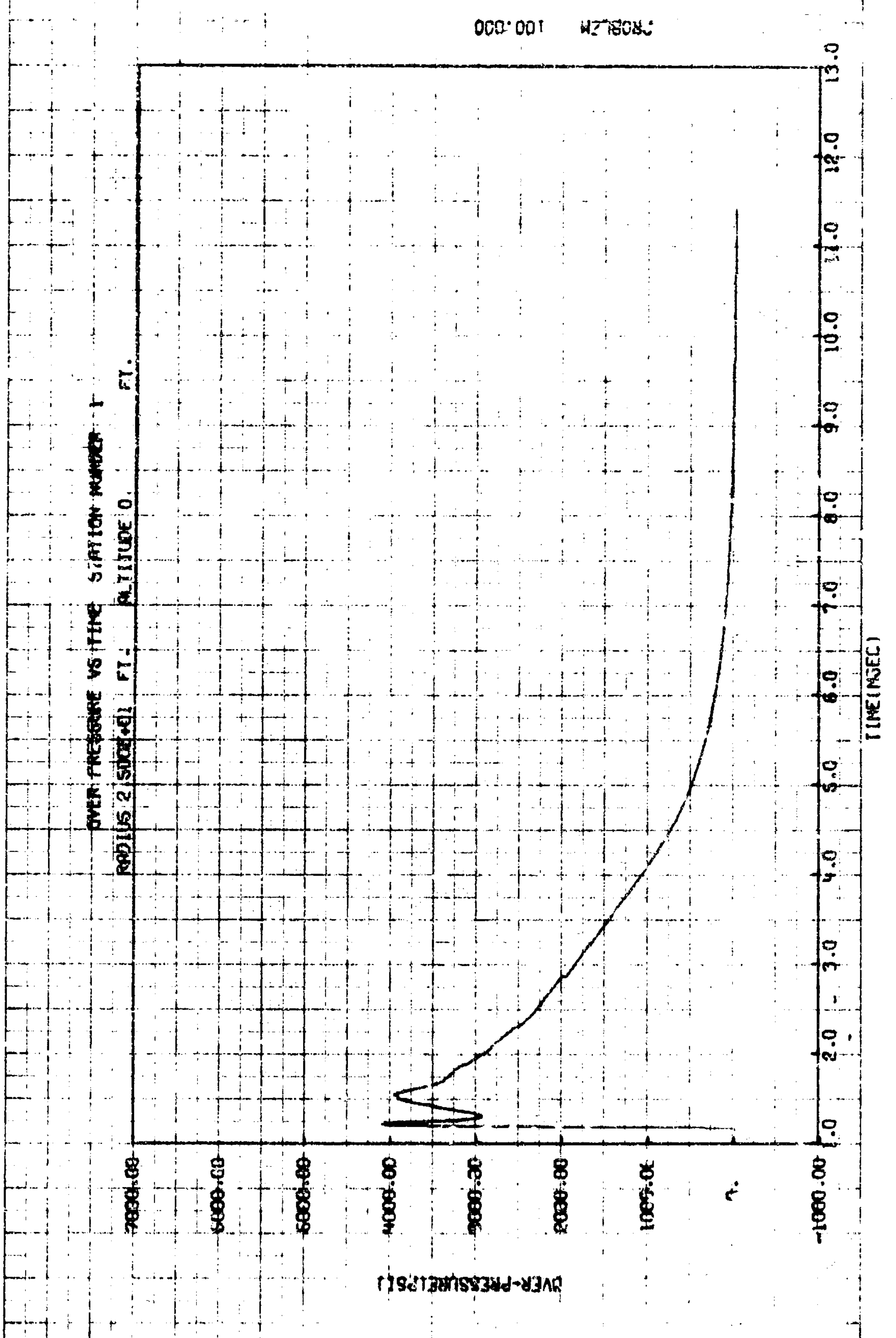

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME
ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE
140000
120000
100000
80000
60000
40000
20000
0
-20000
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

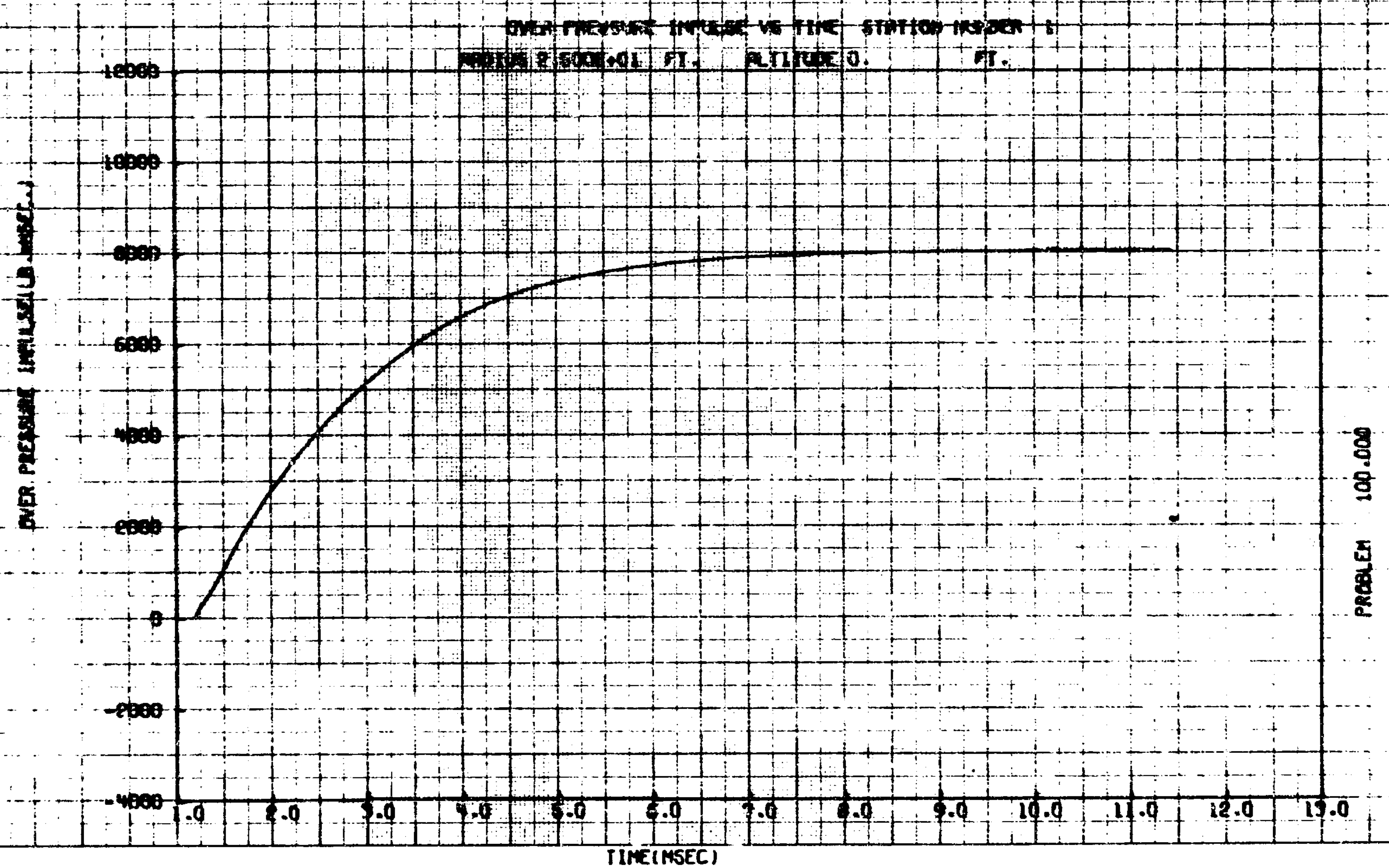


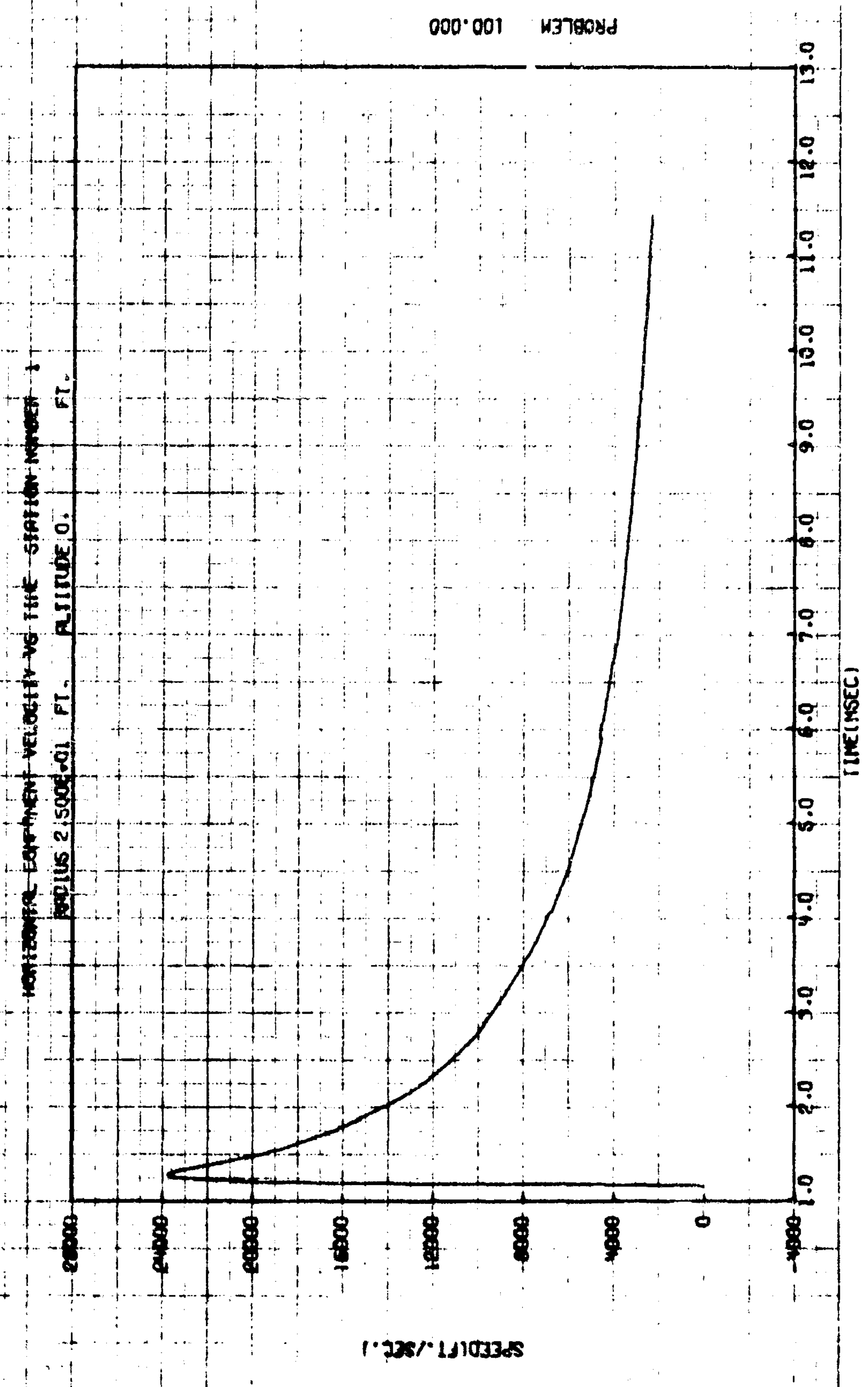
VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
120.00
80.00
40.00
0.
-40.00
-80.00
-120.00
-160.00
-200.00
DYNAMIC PRESSURE(PSI)
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

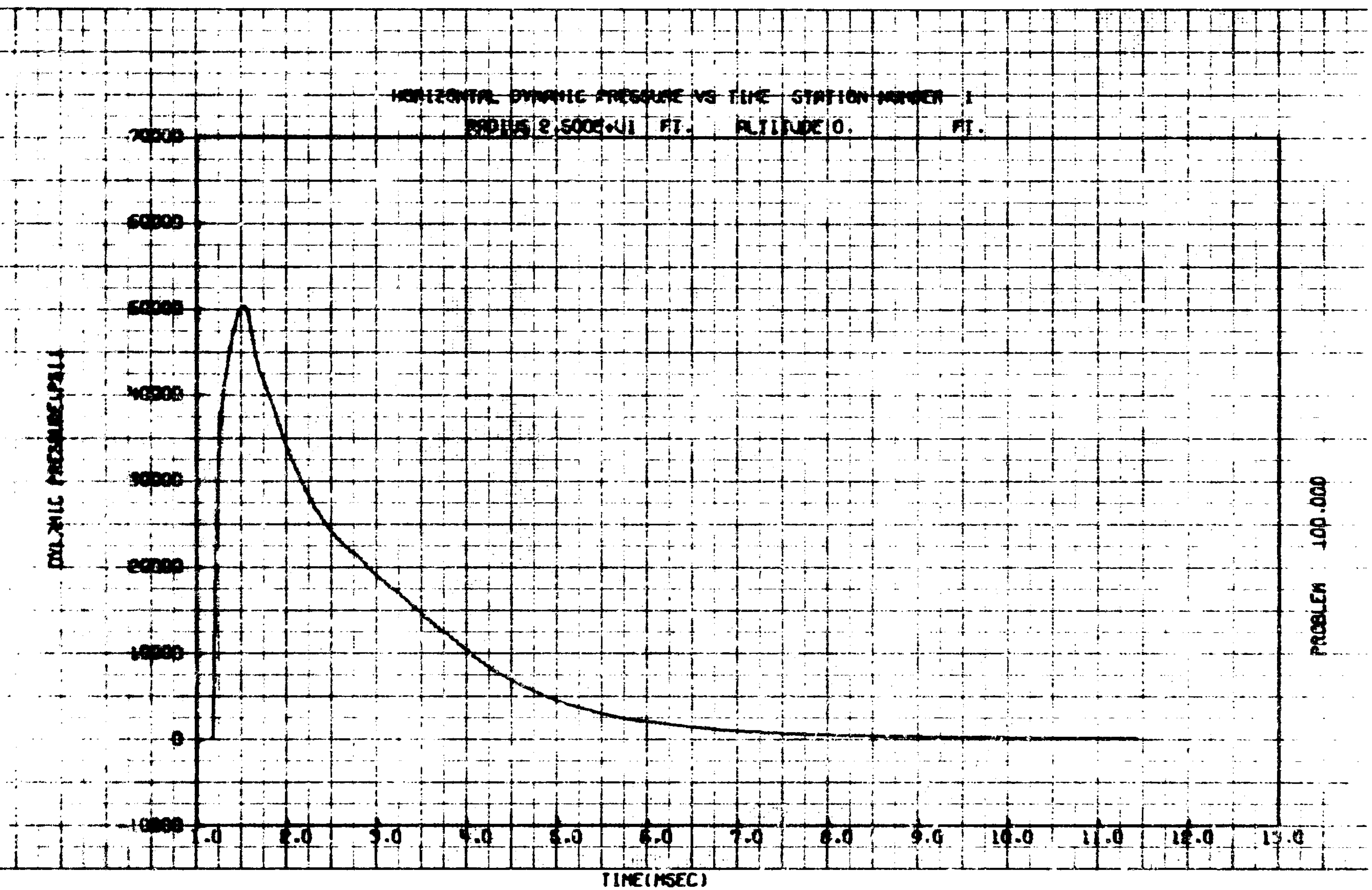


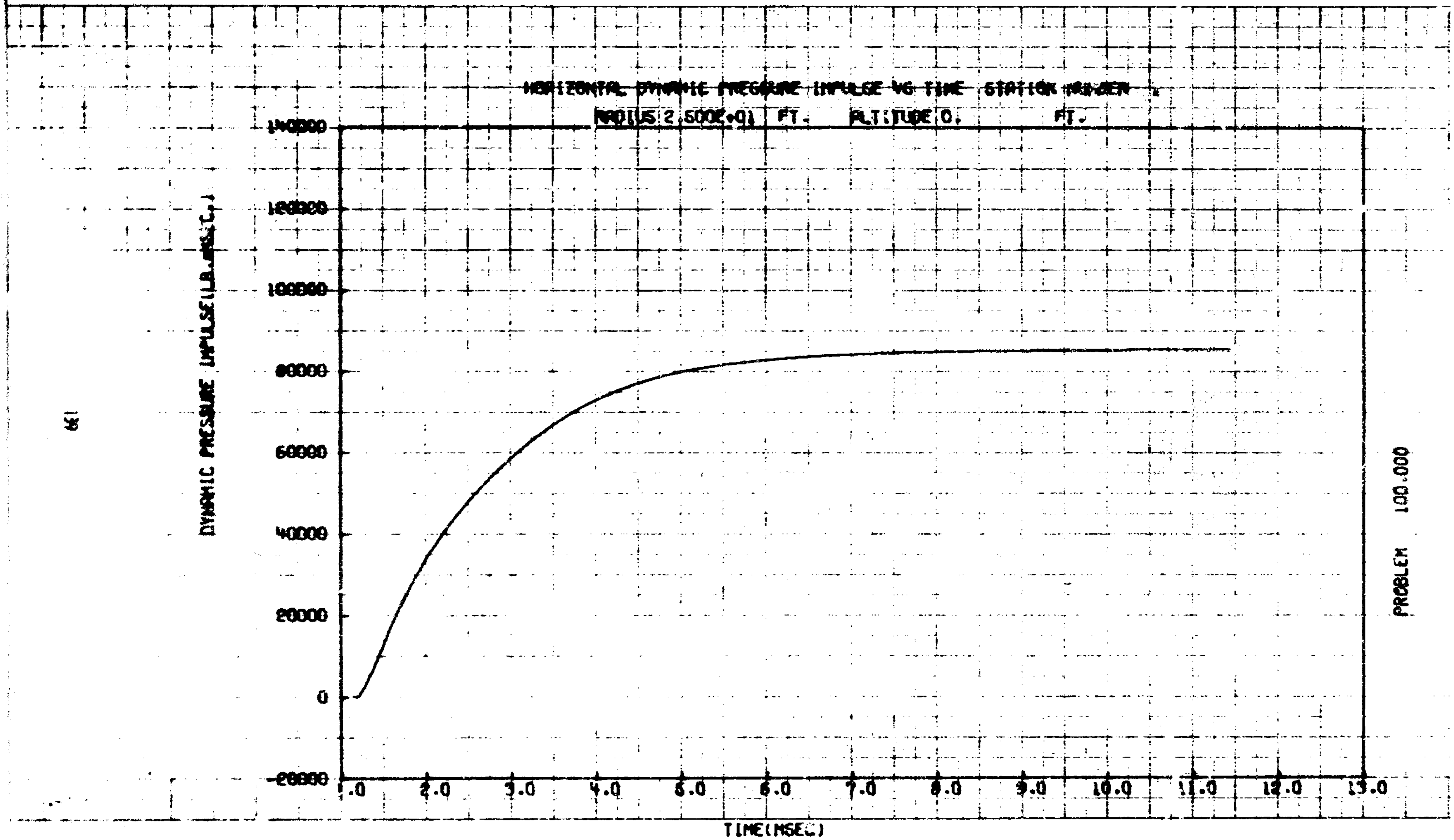
STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB-MSEC)
12.00
8.00
4.00
0.
-4.00
-8.00
-12.00
-16.00
-20.00
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
TIME(MSEC)
PROBLEM 100.000

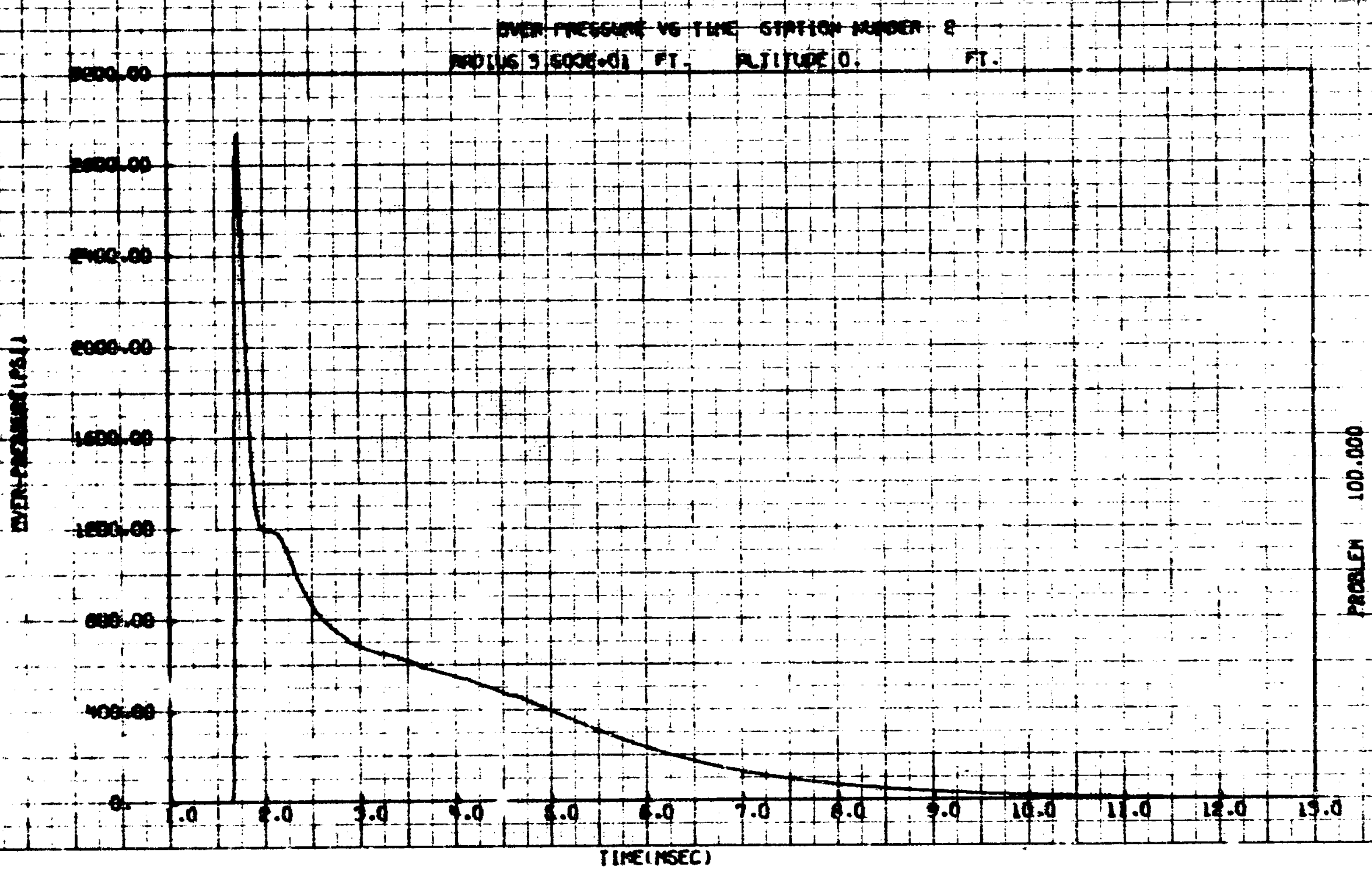

OVER PRESSURE VS TIME STATION NUMBER 1
RADIUS 2.50E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
OVER-PRESSURE(PSI)
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
-1000.00
TIME(MSEC)
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 1
RADIUS 2.500E+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB-MSEC.)
12000
10000
8000
6000
4000
2000
0
-2000
-4000
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
TIME(MSEC)
PROBLEM 100.000

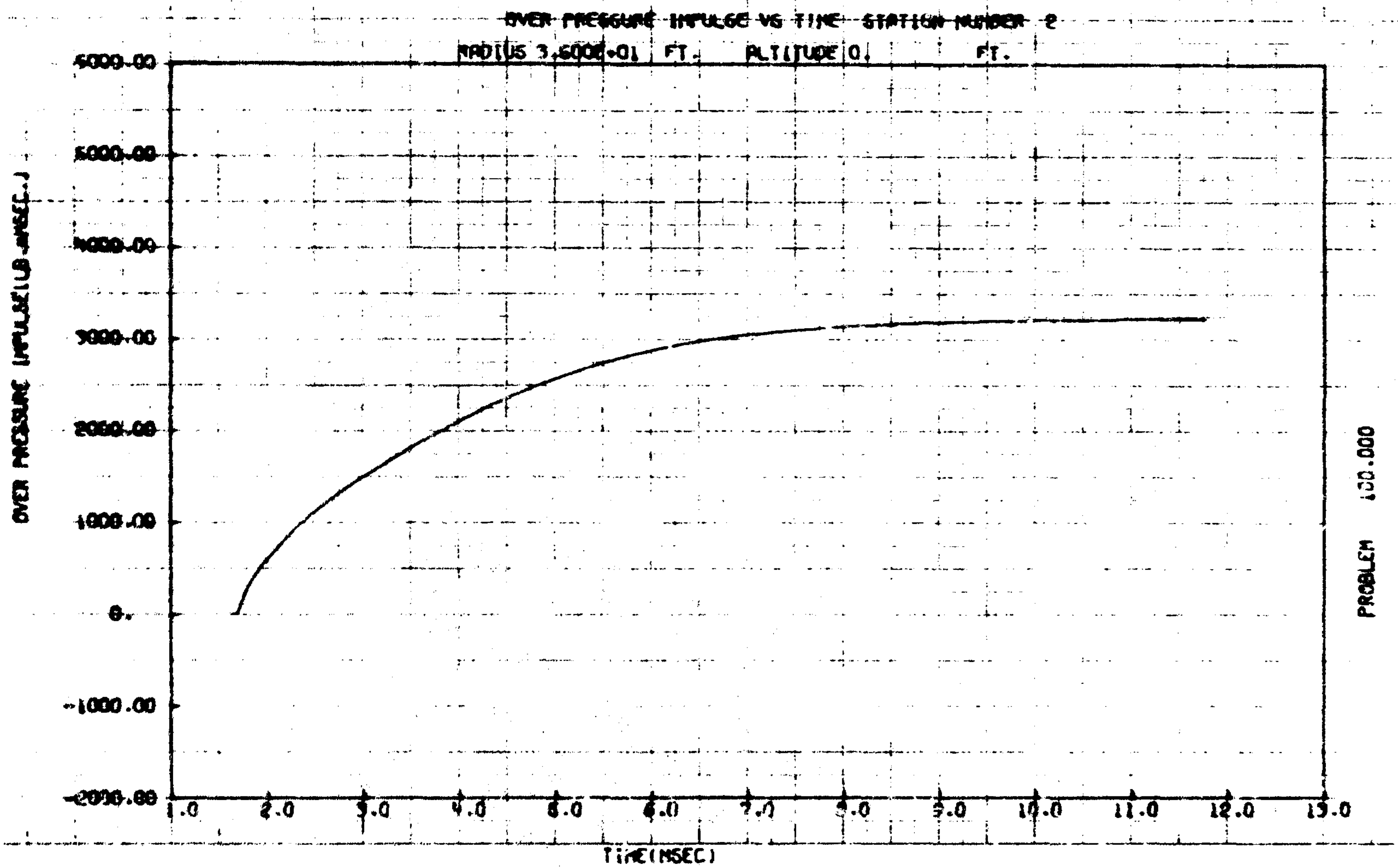

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 1
RADIUS 2.500E-01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
SPEED(FT./SEC.)
28000
24000
20000
16000
12000
8000
4000
0
-4000
TIME(MSEC)
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0

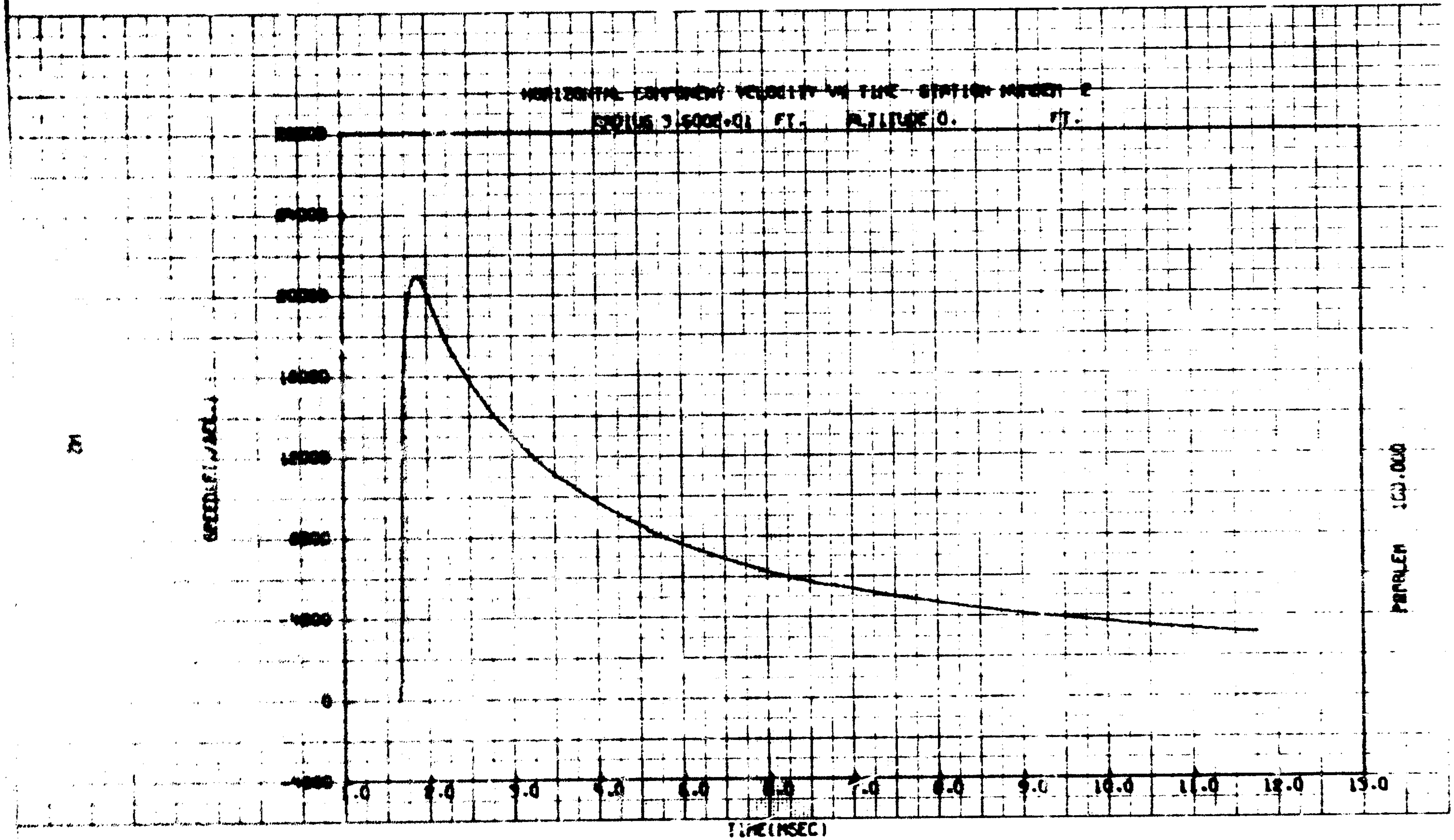

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 1
RADIUS 2.500E+01 FT. ALTITUDE 0. FT.
70000
60000
50000
40000
30000
20000
10000
0
-10000
DYNAMIC PRESSURE(PSI)
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
TIME(MSEC)
PROBLEM 100.000

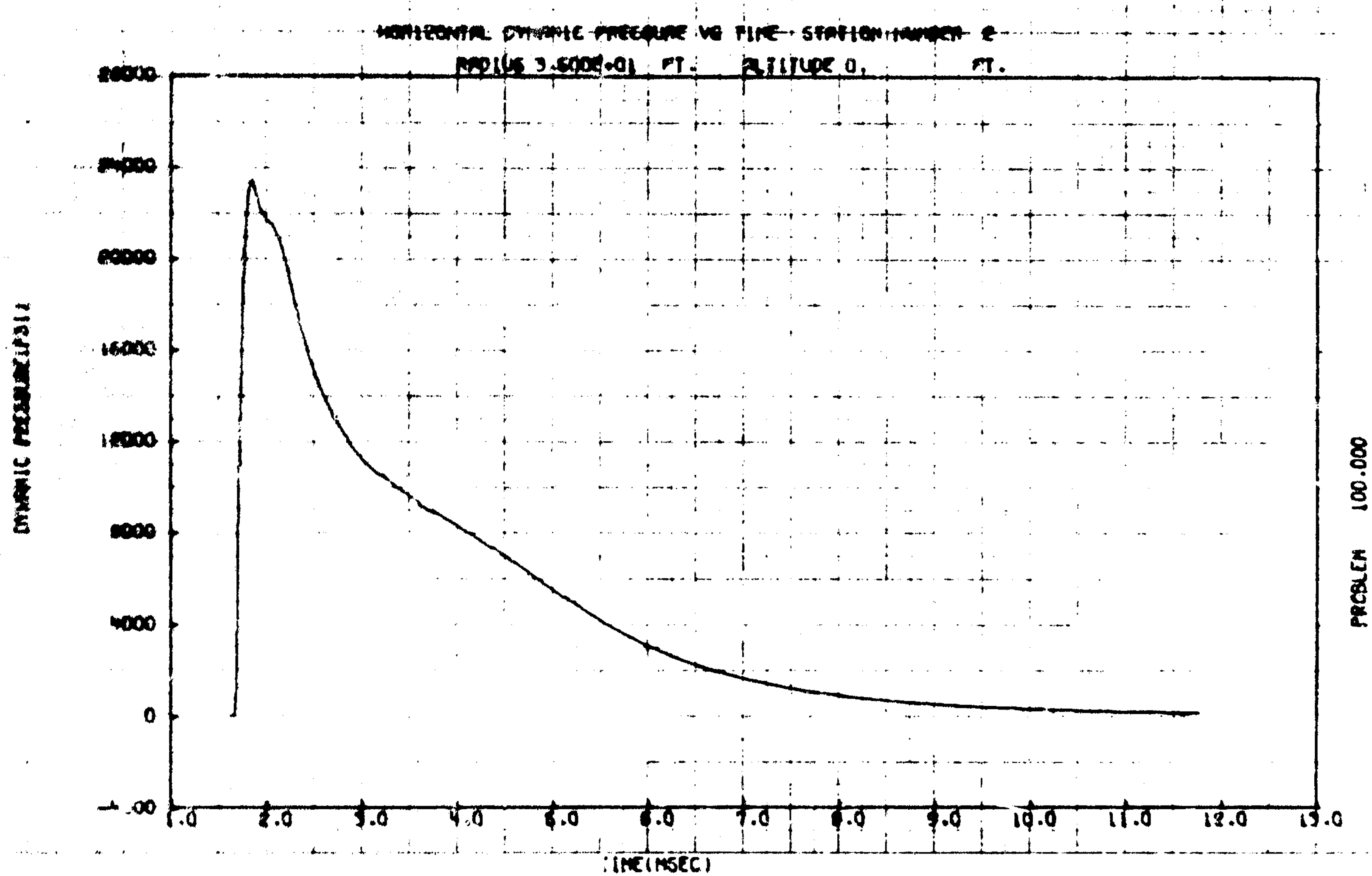

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER
RADIUS 2.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.-MSEC.)
140000
120000
100000
80000
60000
40000
20000
0
-20000
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
TIME(MSEC)
PROBLEM 100.000



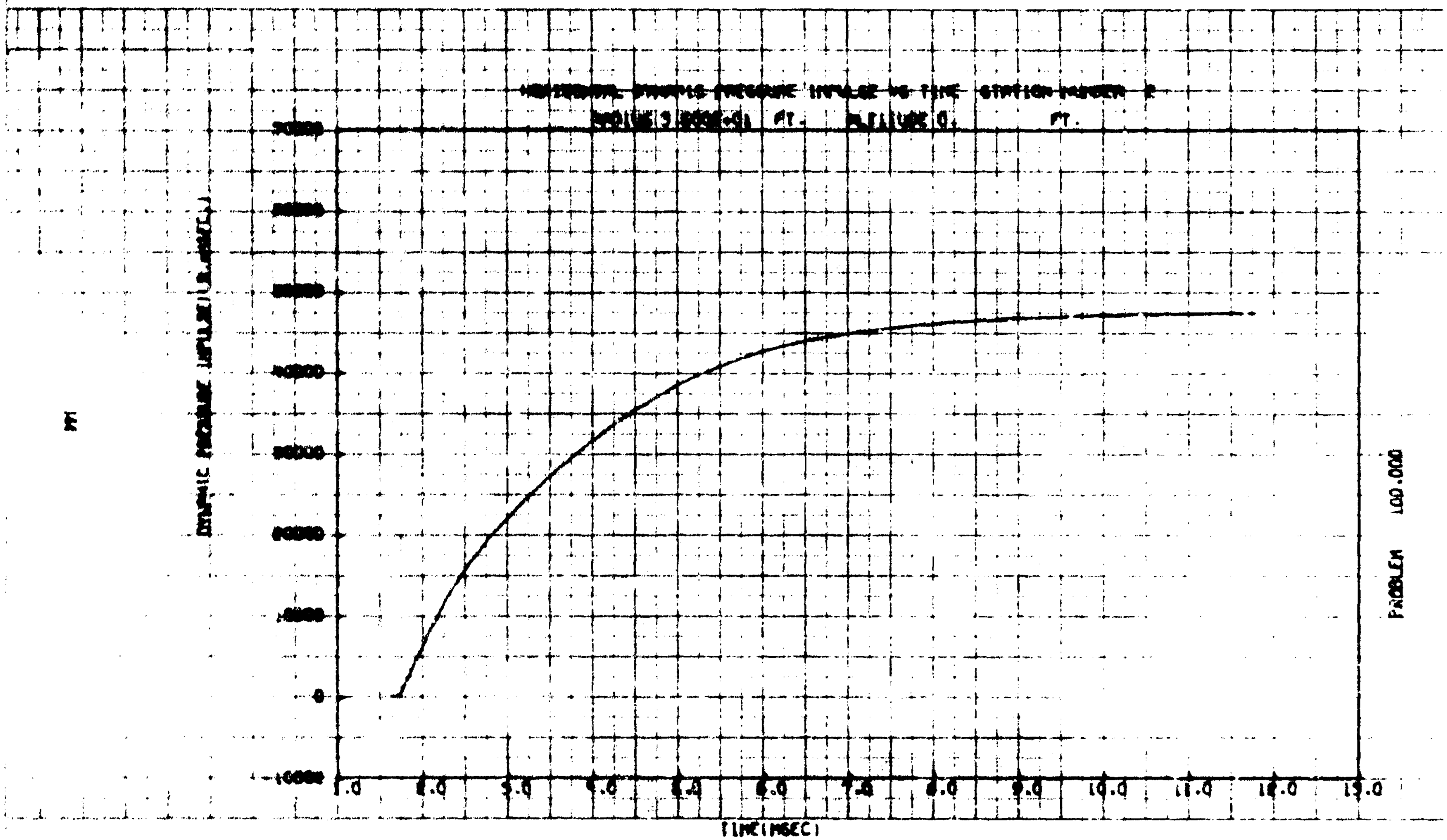
OVER PRESSURE VS TIME STATION NUMBER 8
RADIUS 3.6000E+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
3200.00
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
TIME(MSEC)
PROBLEM 100.000

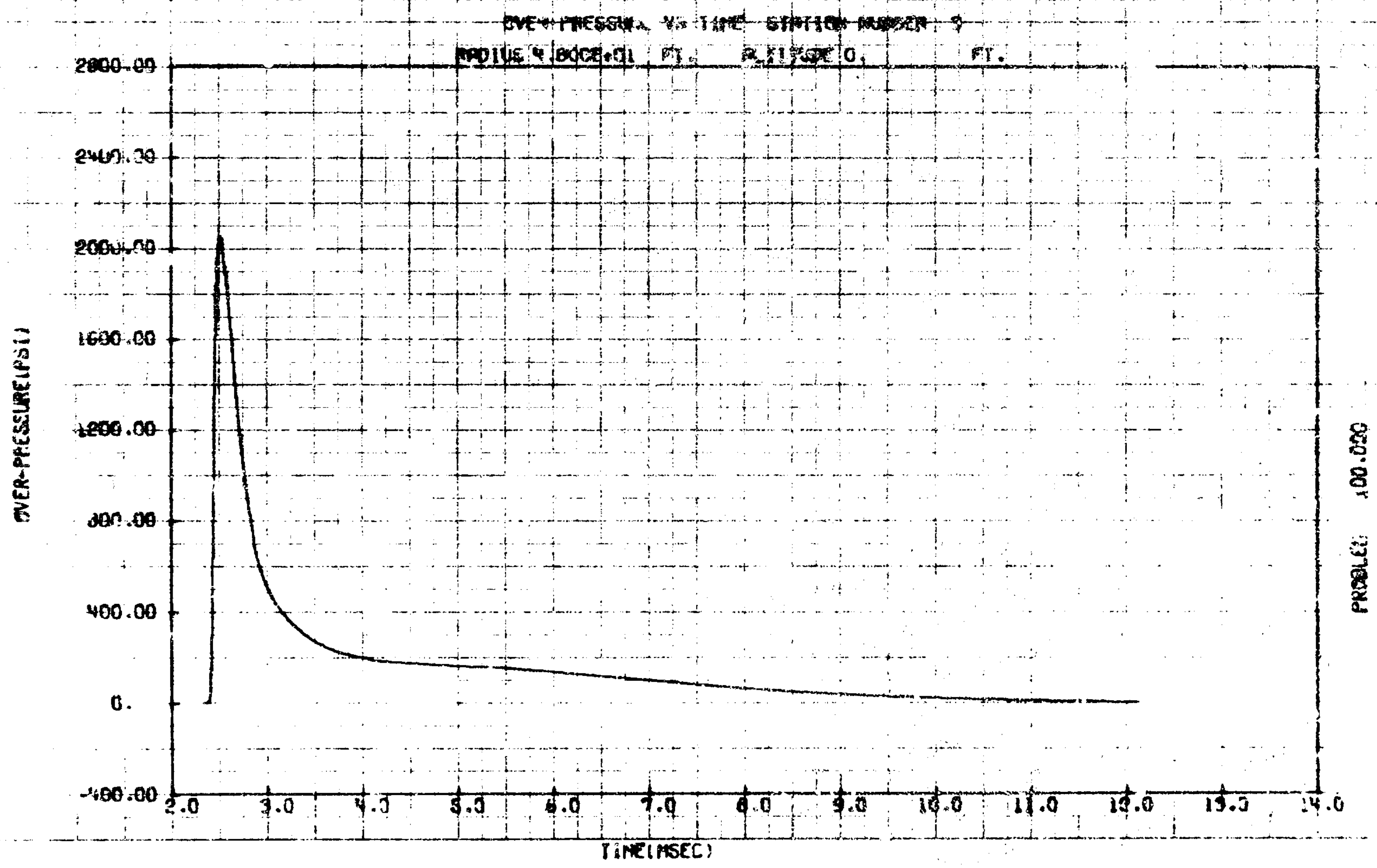

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 2
RADIUS 3.6000+01 FT. ALTITUDE 0. FT.
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
-2000.00
OVER PRESSURE IMPULSE(LB.-MSEC.)
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
TIME(MSEC)
PROBLEM 100.000

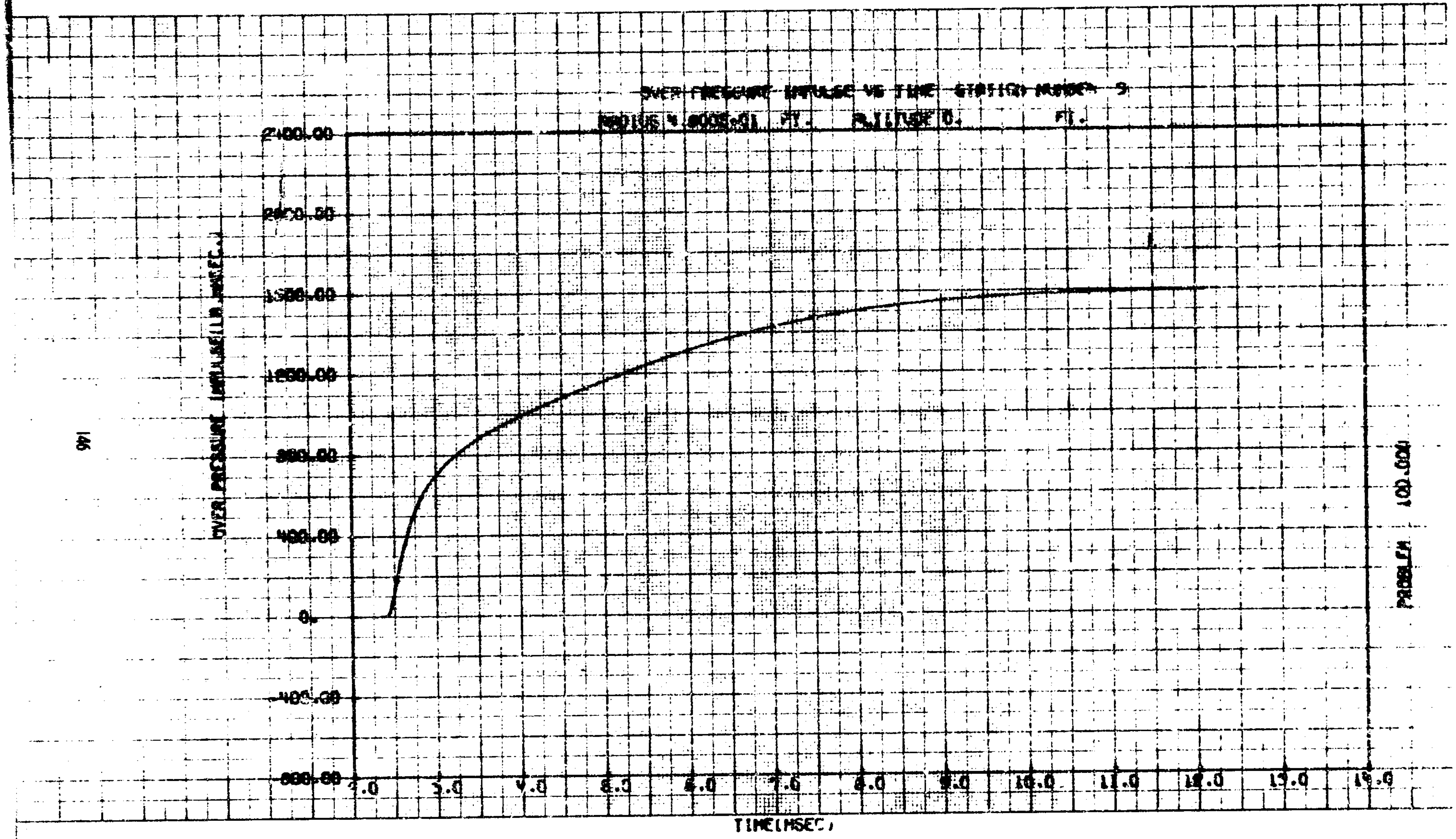

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 2
FT. ALTITUDE 0. FT.
SPEED(FT/SEC)
0
TIME(MSEC)
2.0
3.0
4.0
5.0
6.0
8.0
9.0
10.0
11.0
12.0
13.0
PROBLEM

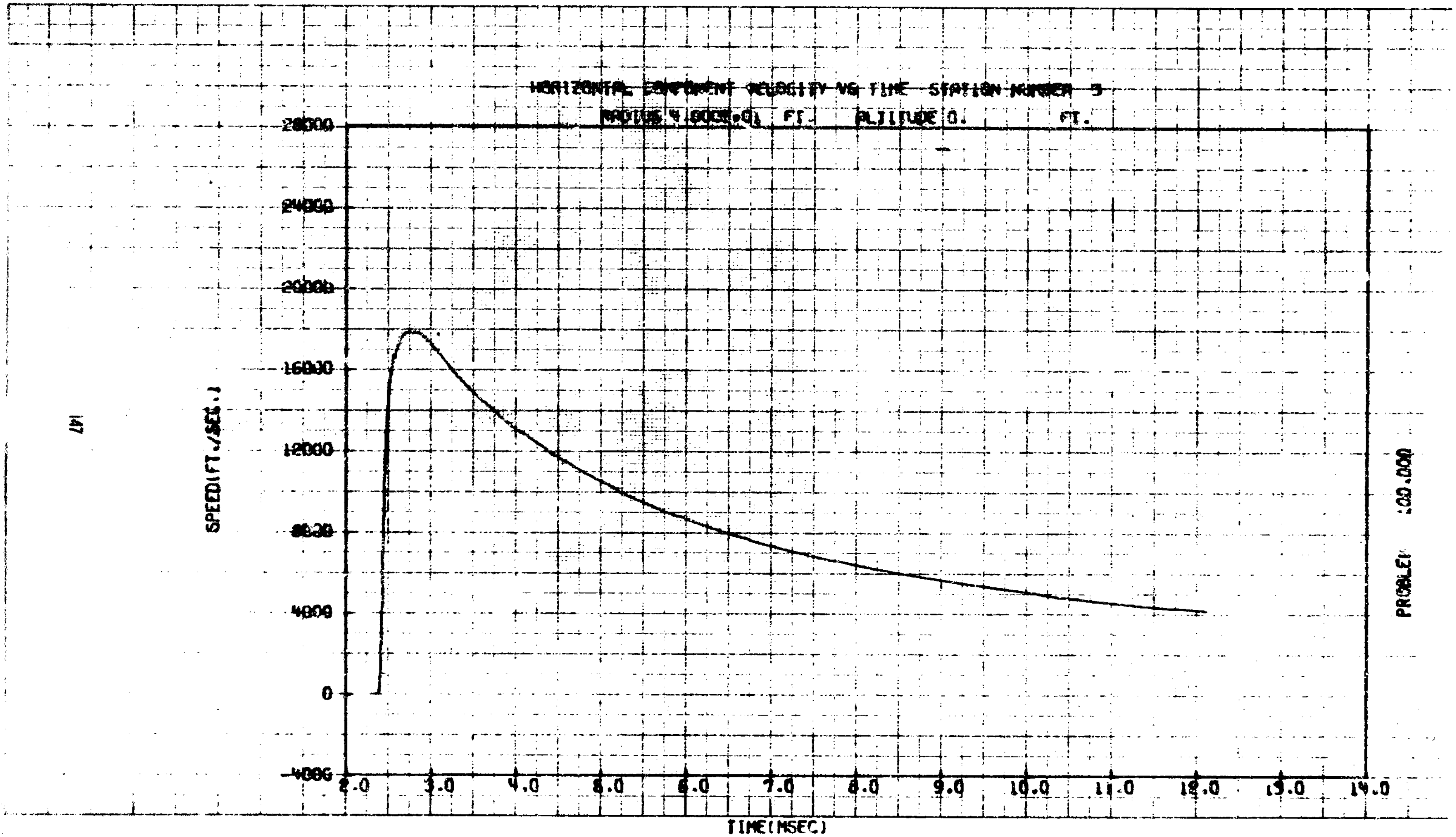


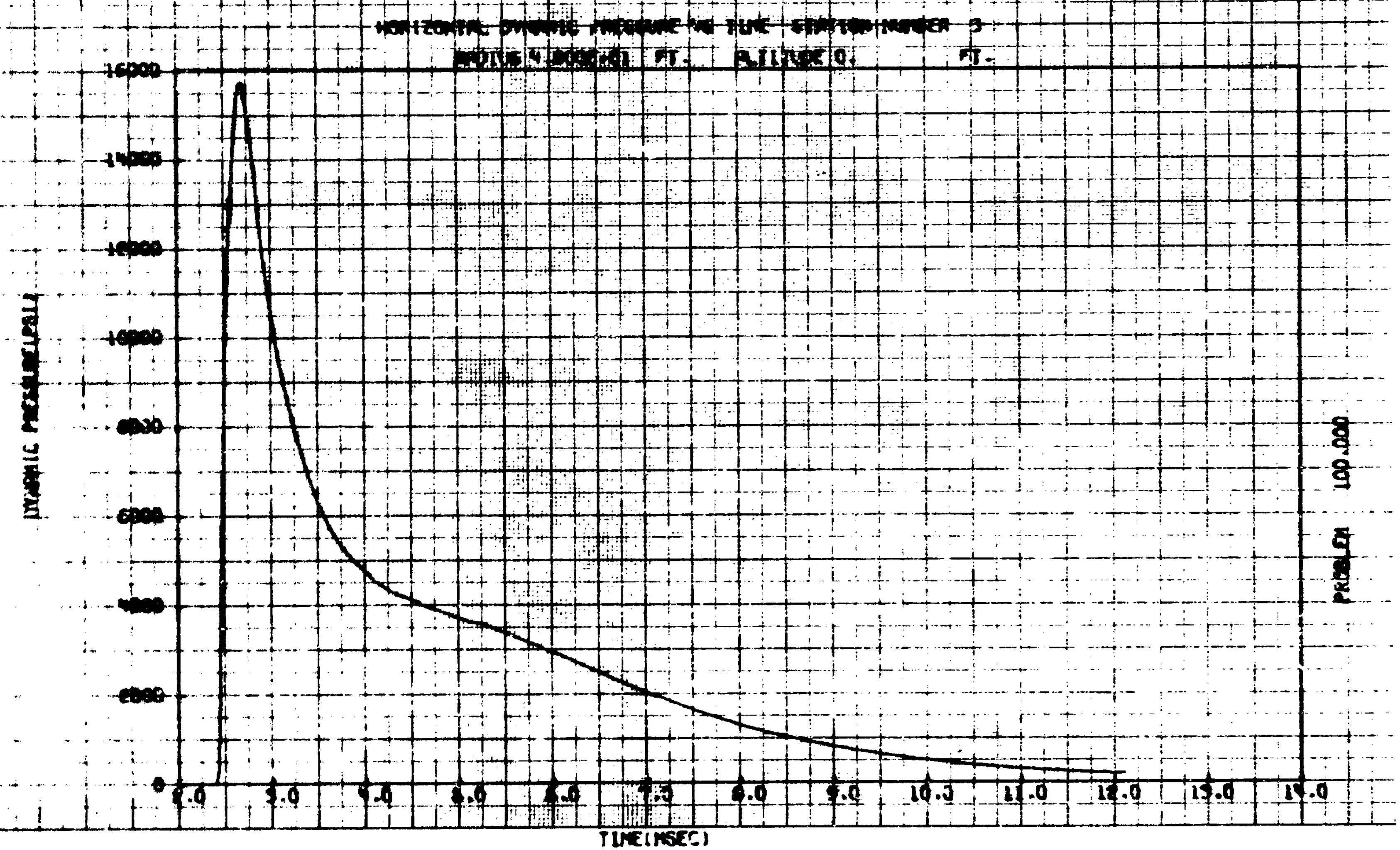
HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER
RADIUS 3.600E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
24000
20000
16000
12000
8000
4000
0
TIME(MSEC)
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
PROBLEM 100.000


FT.
0
TIME(MSEC)
10.0
11.0
PROBLEM 100.000

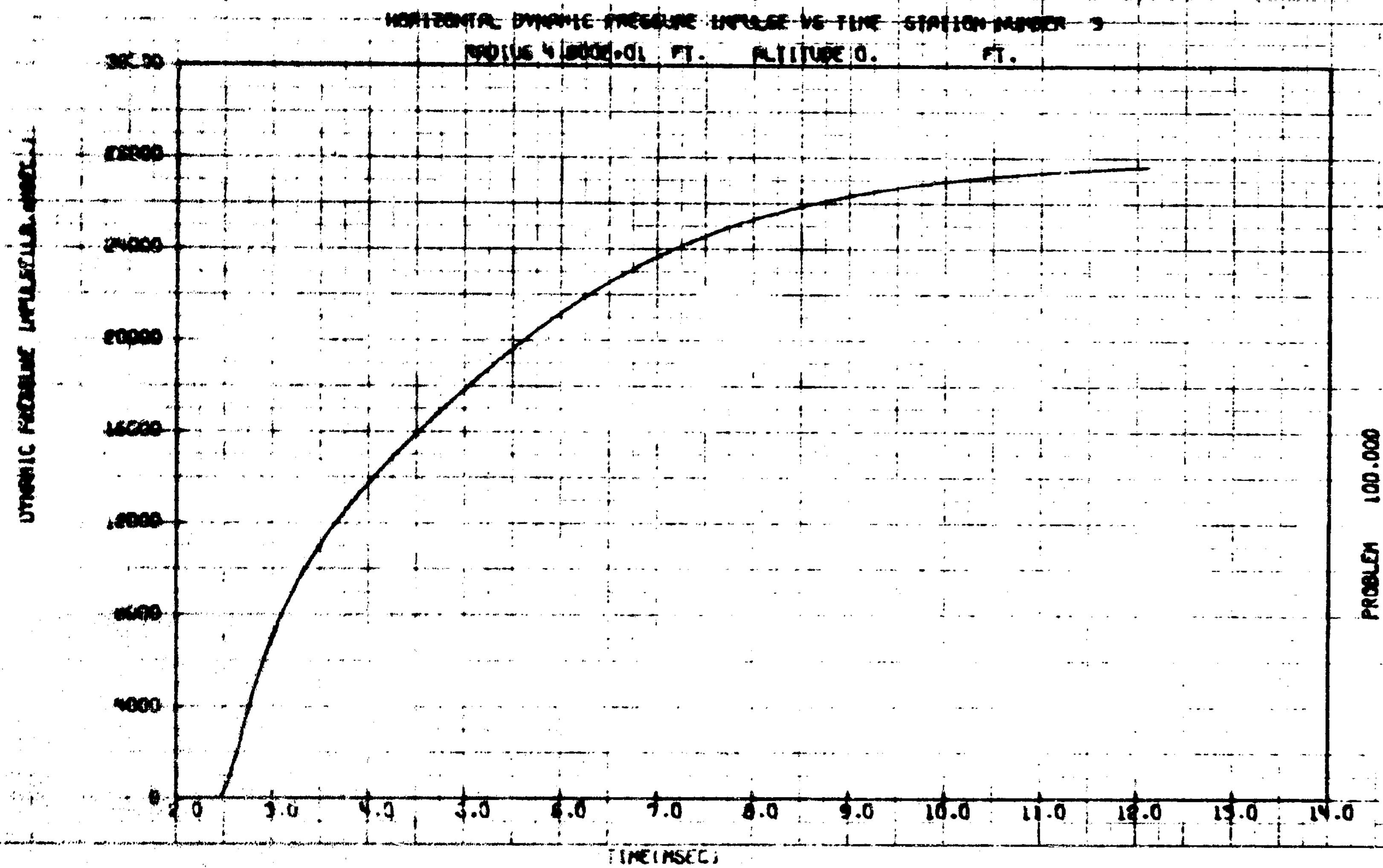

OVER-PRESSURE(PSI)
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)

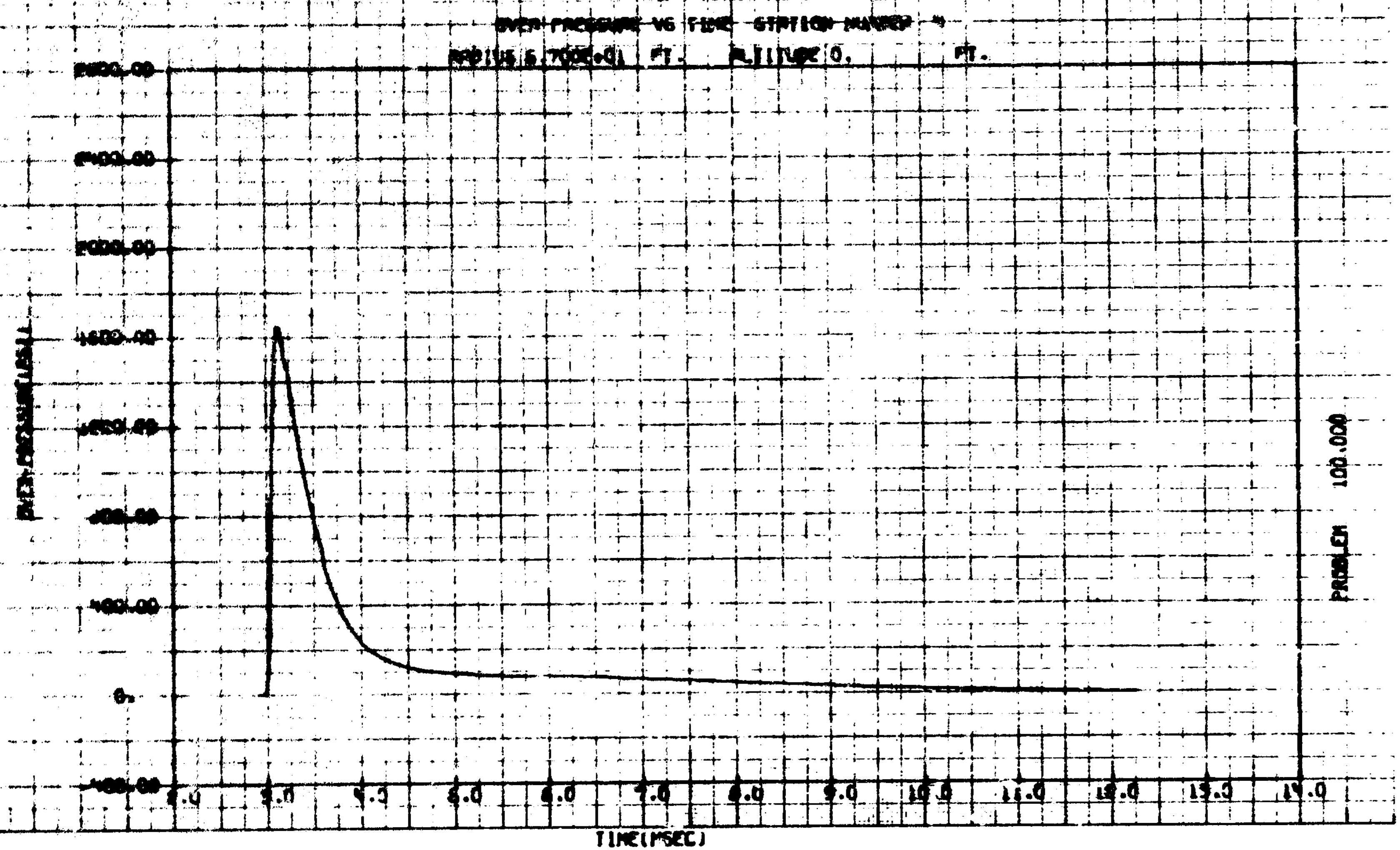

TIME(MSEC)
PROBLEM 100.000
0.

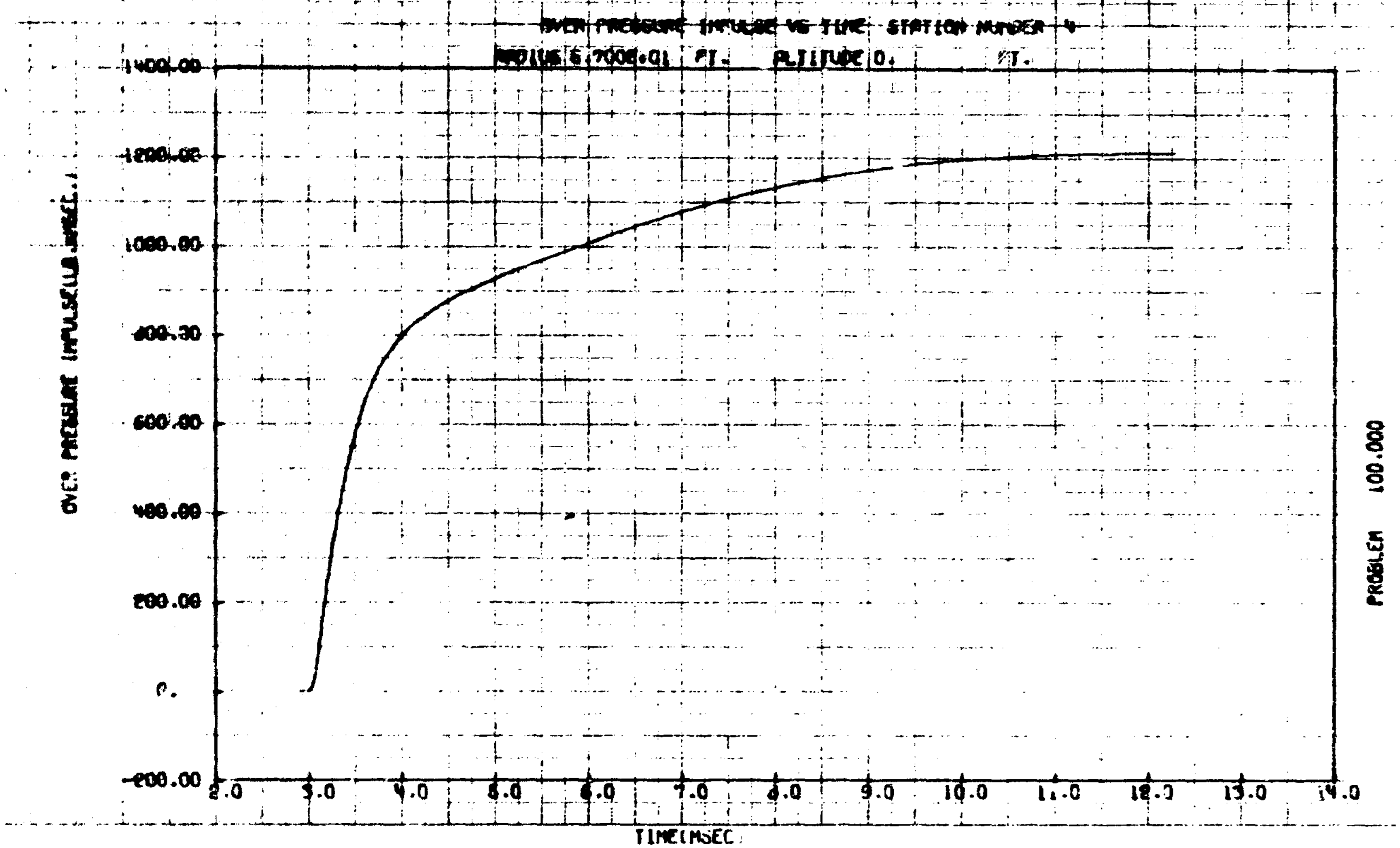

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 5
ALTITUDE 0. FT.
PROBLEM 100.000
28000
24000
20000
16000
12000
8000
4000
0
-4000
SPEED(FT./SEC.)
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)

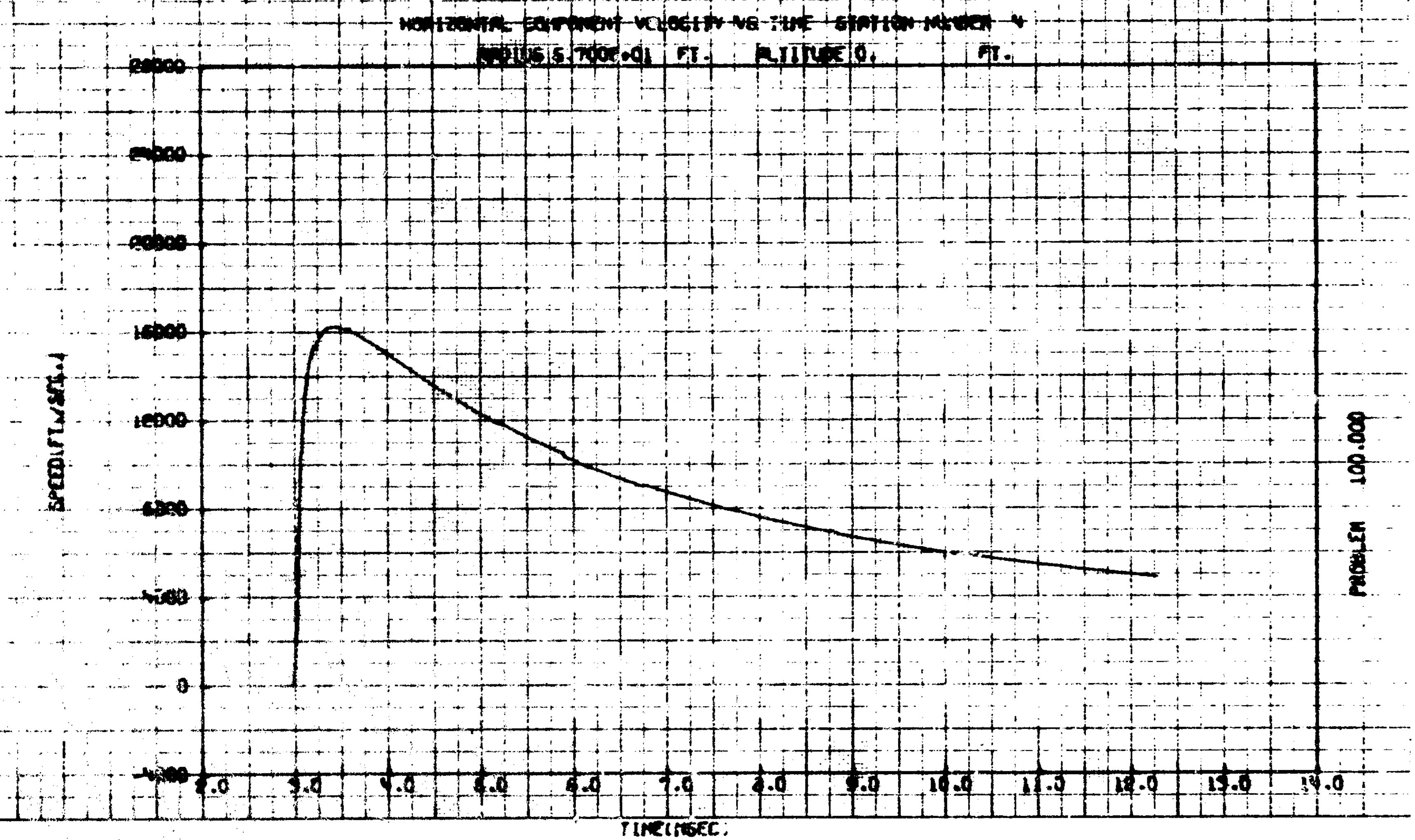


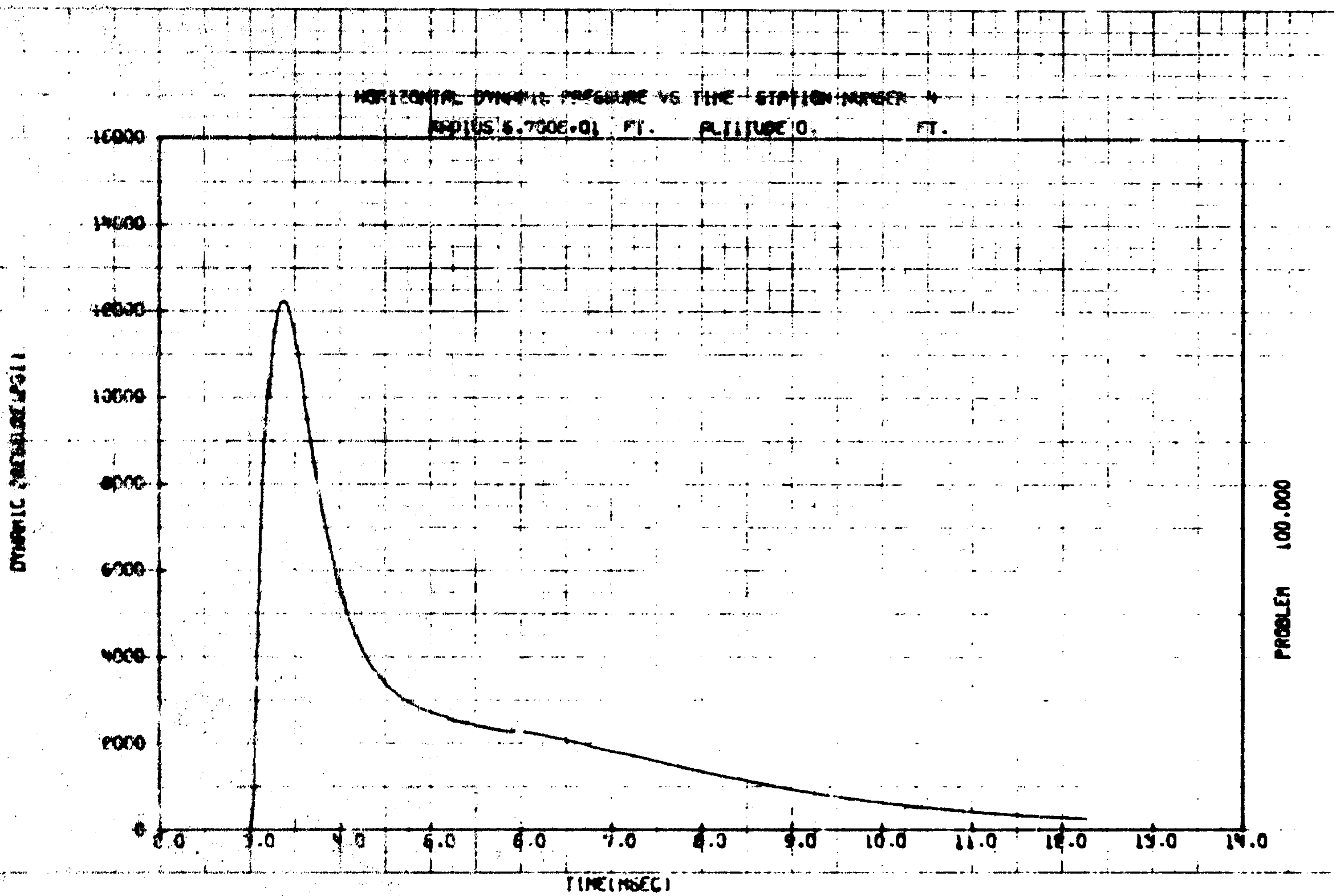
HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 3
FT. ALTITUDE 0. FT.
16000
14000
12000
10000
8000
6000
4000
2000
0
DYNAMIC PRESSURE(PSI)
TIME(MSEC)
10.3
11.0
PROBLEM 100.000


HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 9
RADIUS 4.0000+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB-MSEC)
TIME(MSEC)
PROBLEM 100.000

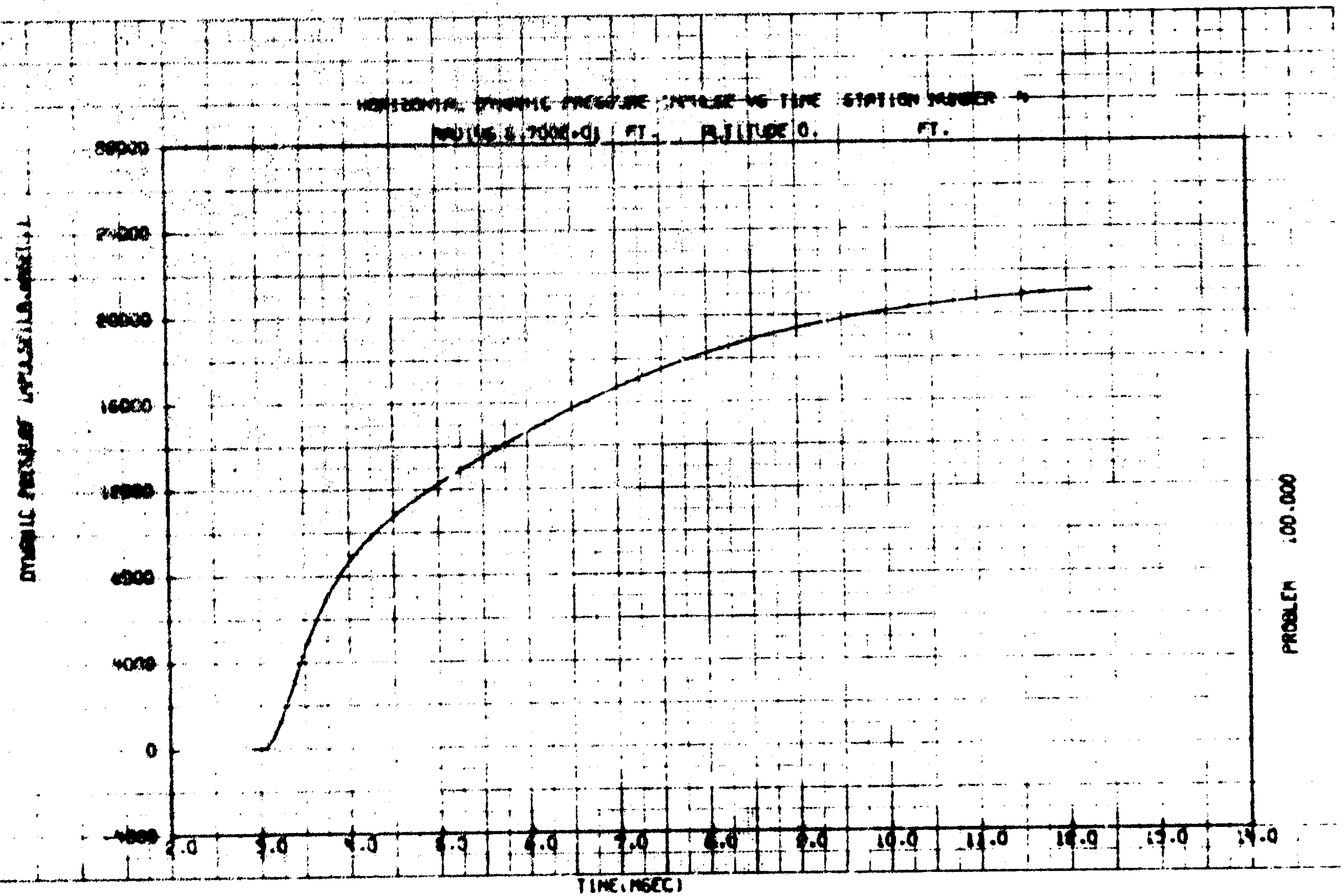

OVER-PRESSURE VS TIME STATION NUMBER 4
RADIUS 5.7000+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
0.


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 4
RADIUS 6.700E+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.MSEC.)
TIME(MSEC)
PROBLEM 100.000
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0

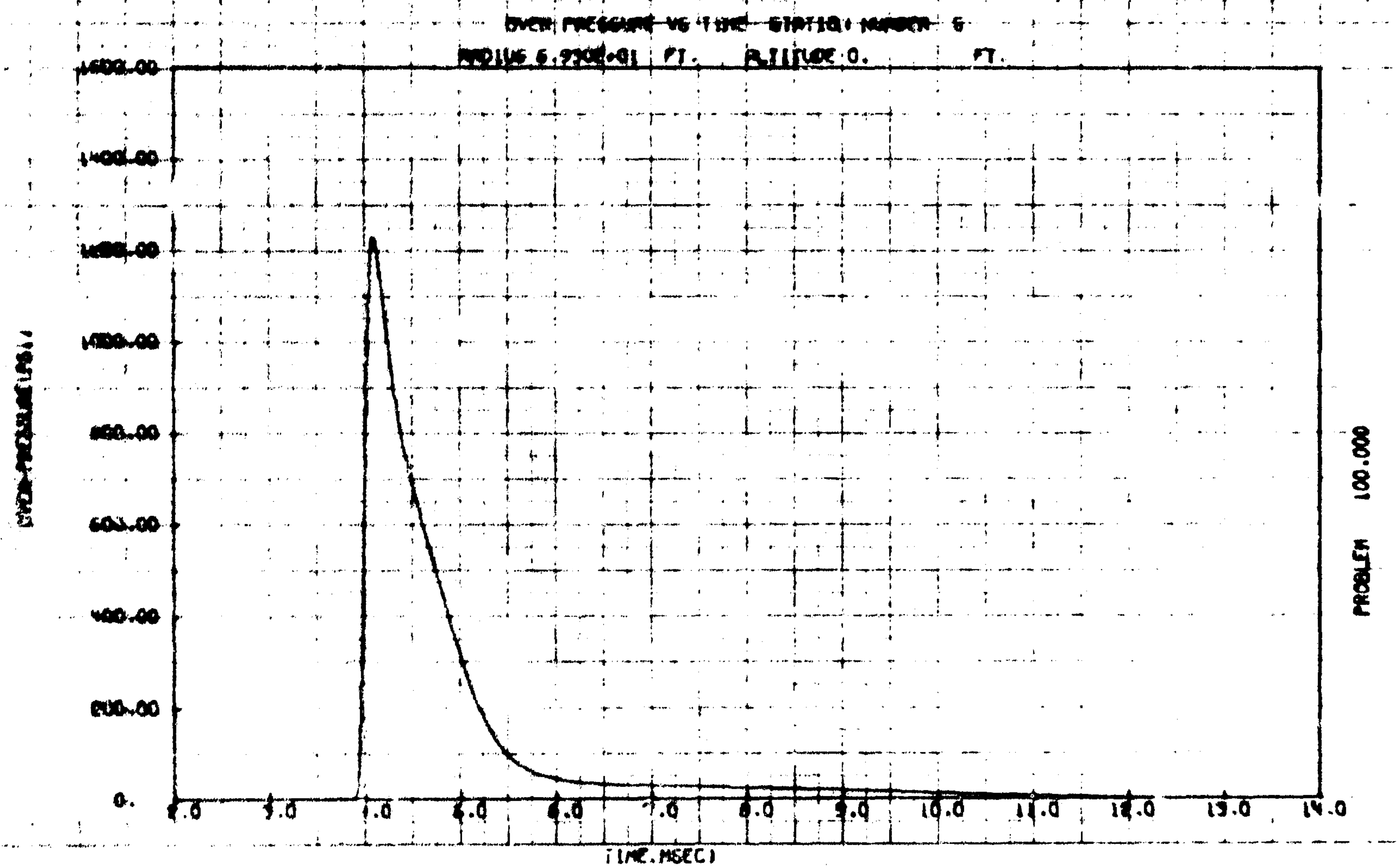

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 4
RADIUS 5.700E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
28000
24000
20000
16000
12000
8000
4000
0
-4000
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC.)
PROBLEM 100.000

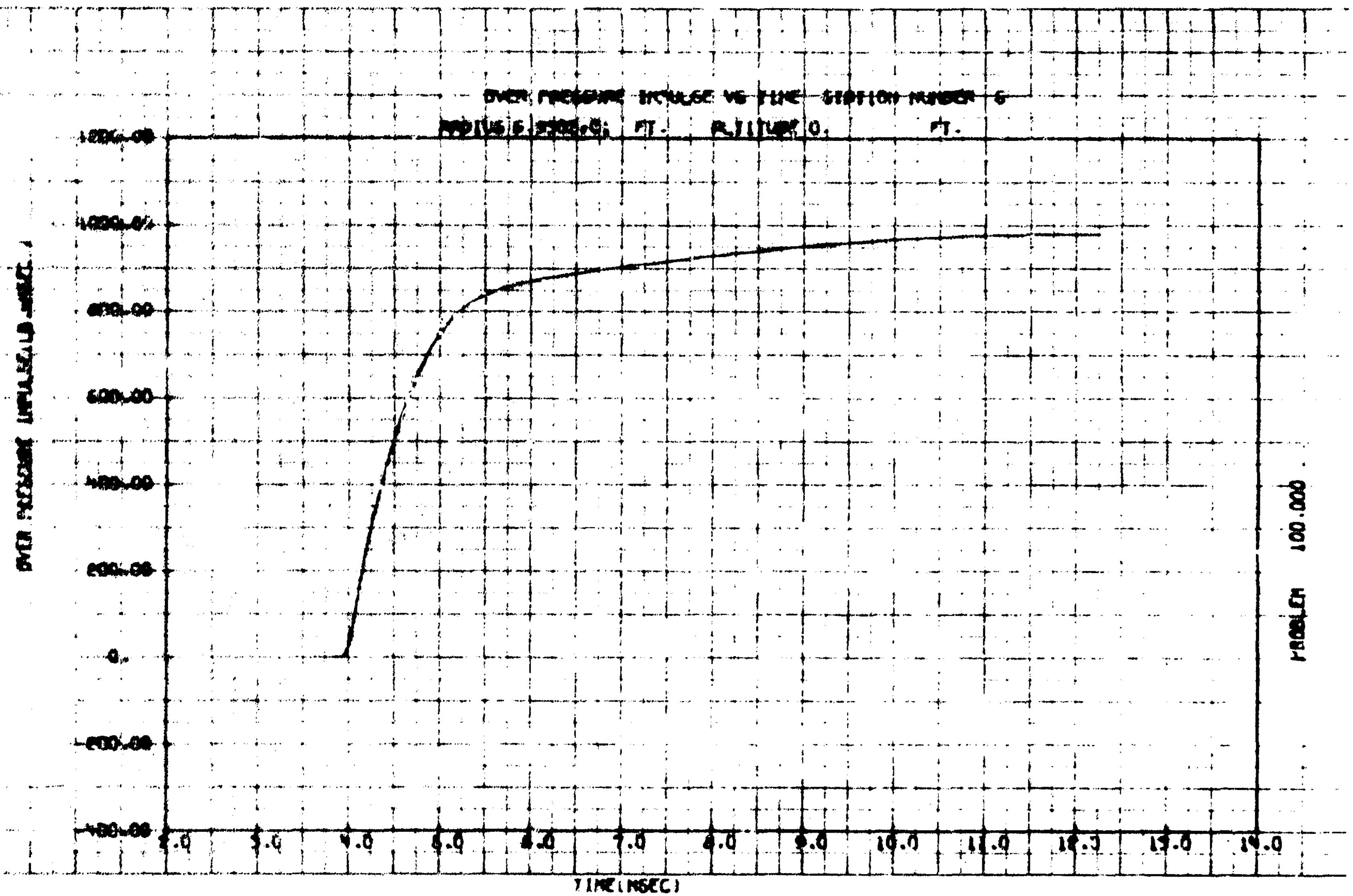


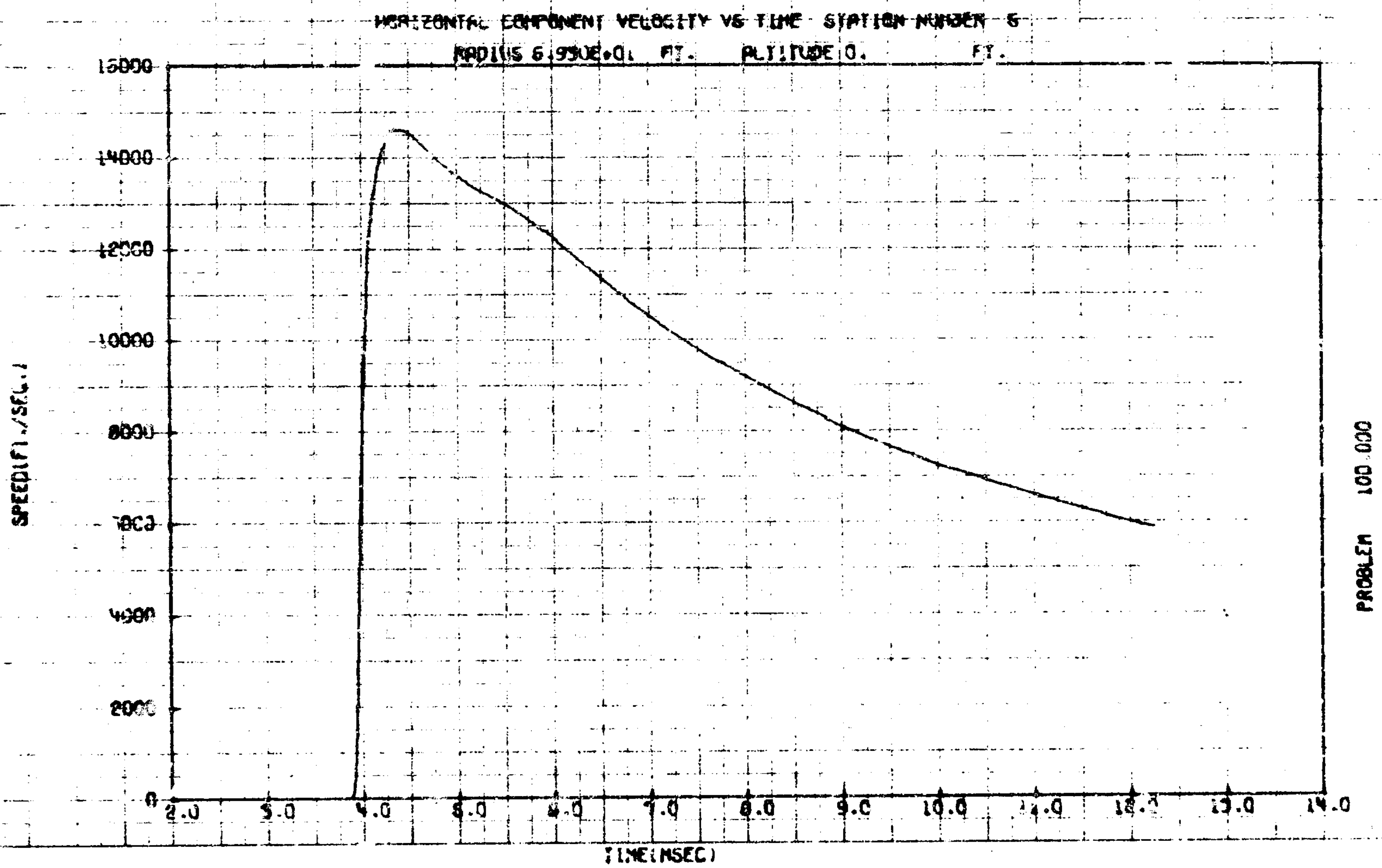
HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 4
RADIUS 5.700E-01 FT. ALTITUDE 0. FT.
16000
14000
12000
10000
8000
6000
4000
2000
0
DYNAMIC
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)
PROBLEM 100.000

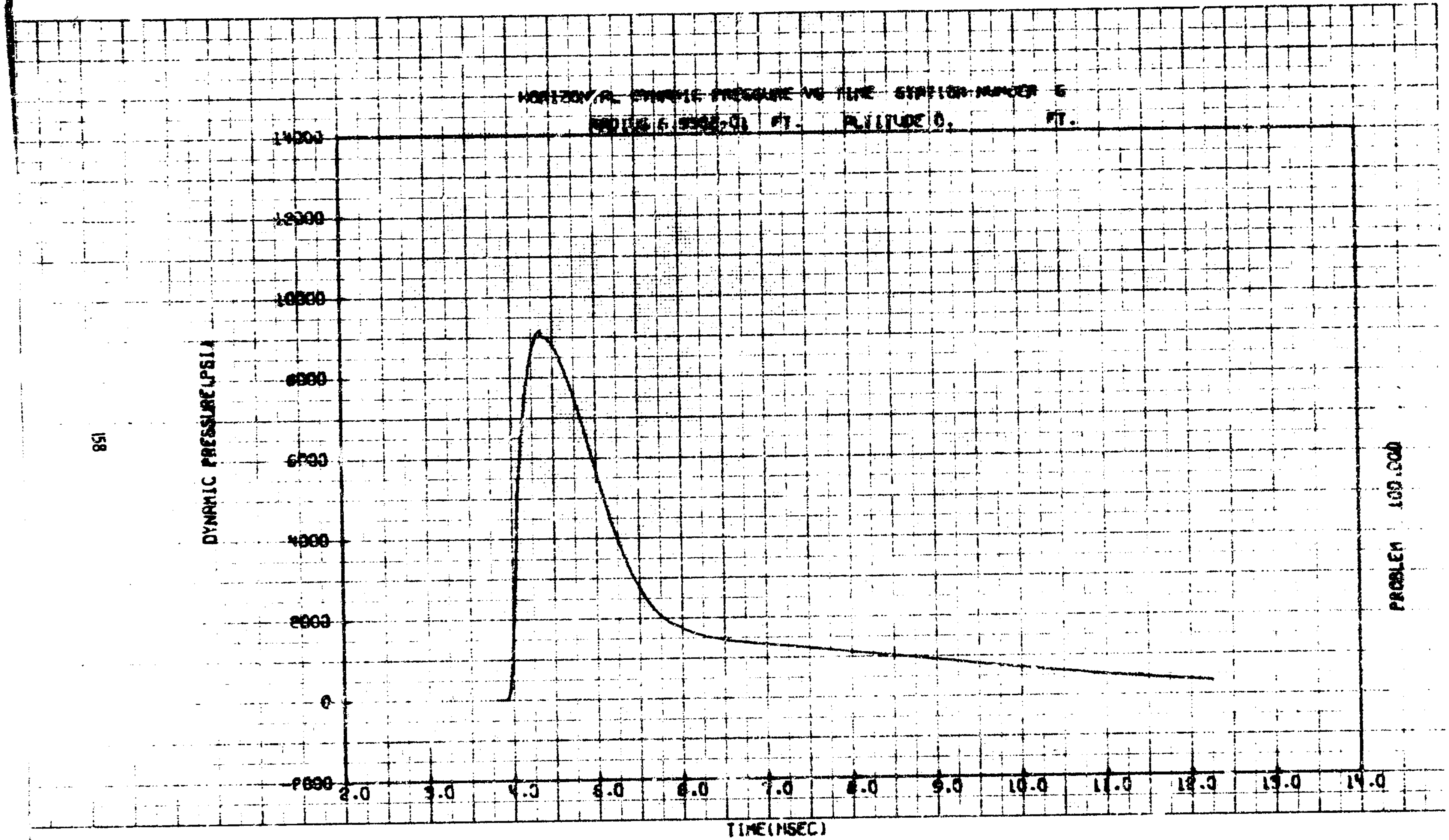


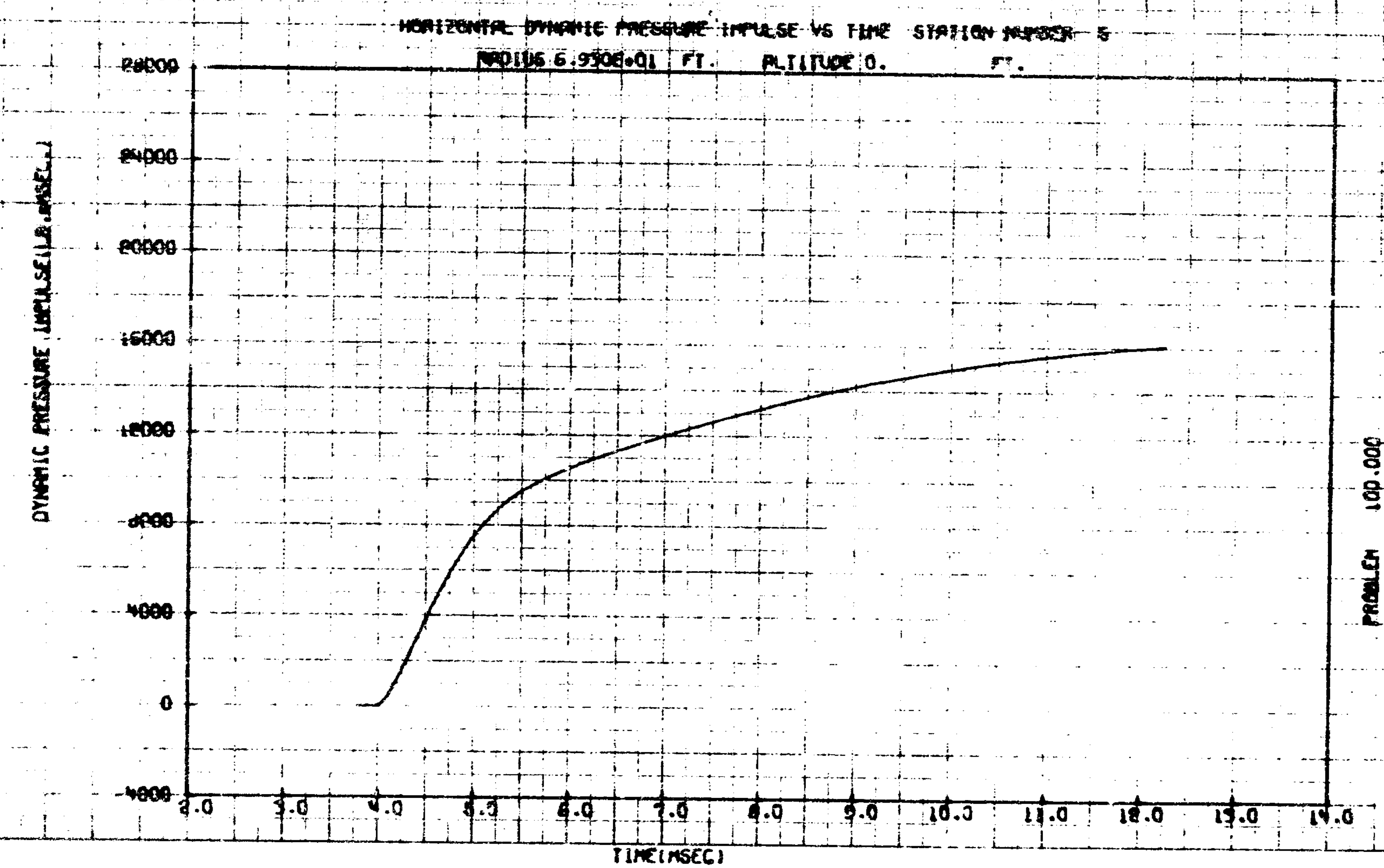
FT.
TIME,MSEC)
PROBLEM 100.000
28000
24000
20000
16000
12000
8000
4000
0
-4000
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0

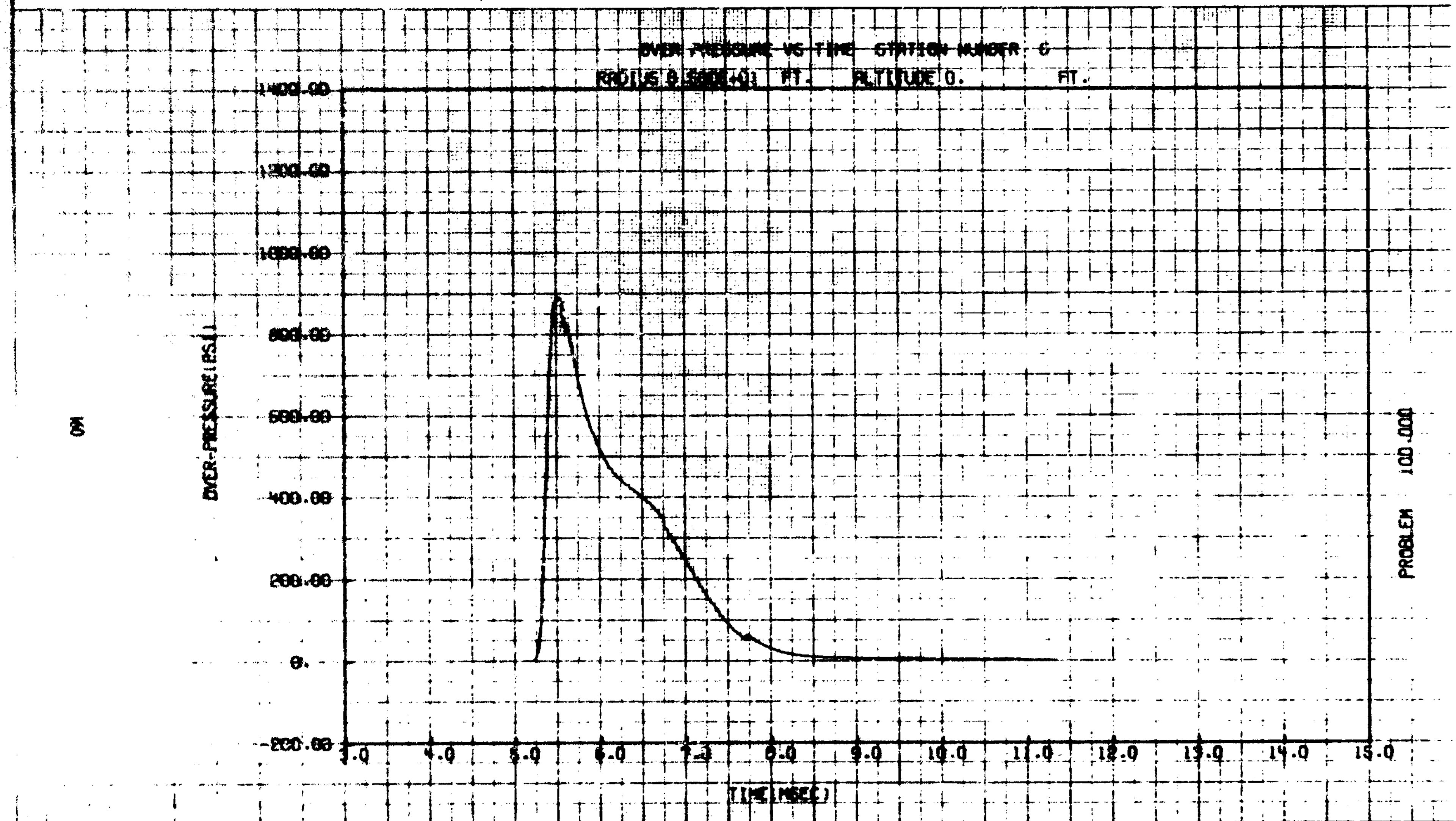

OVER PRESSURE VS TIME STATION NUMBER 6
RADIUS 6.930E+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
0.
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
1600.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME,MSEC)
PROBLEM 100.000

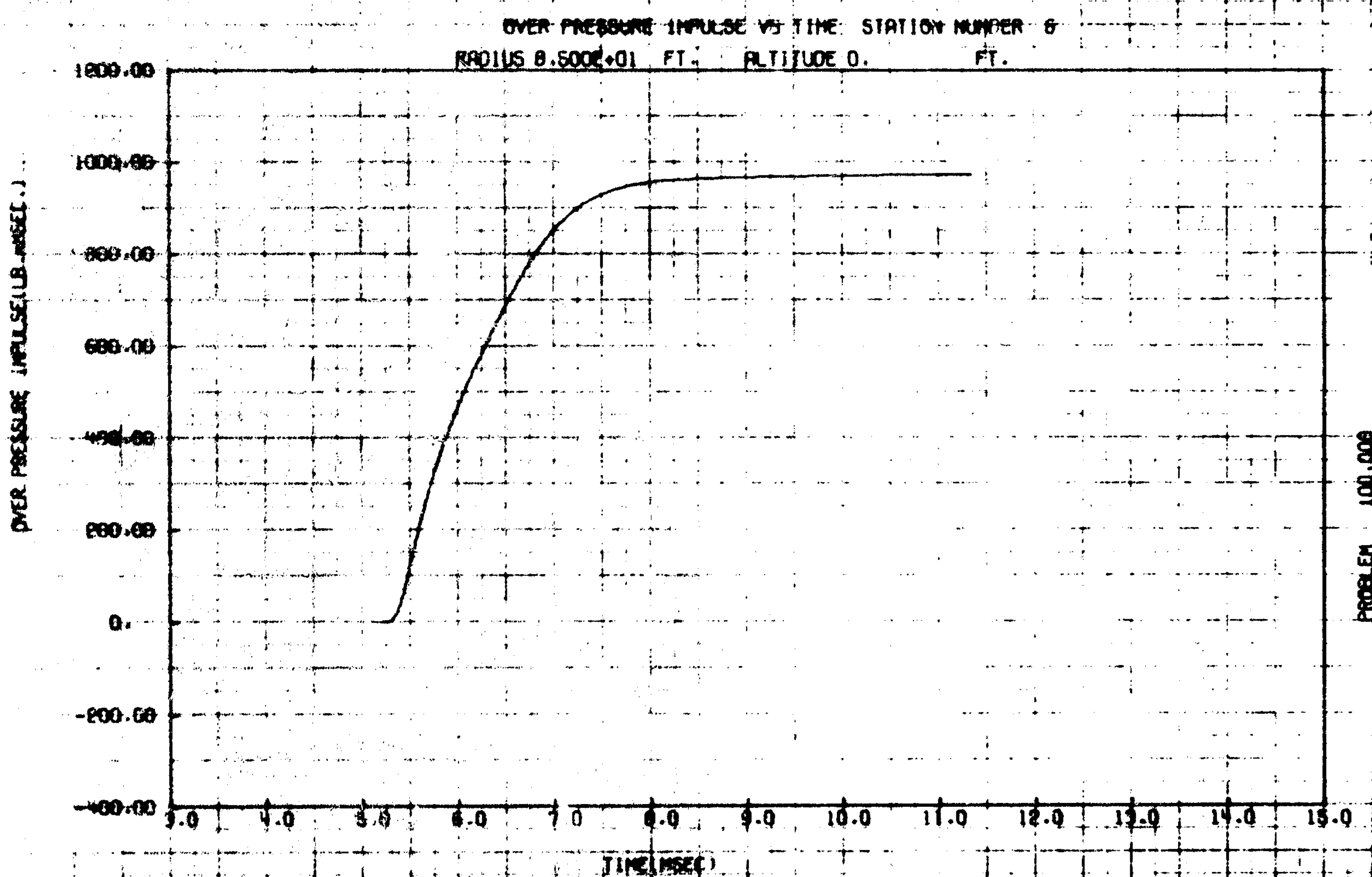

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 6
RADIUS FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB-MSEC.)
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-400.00
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)
PROBLEM 100.000

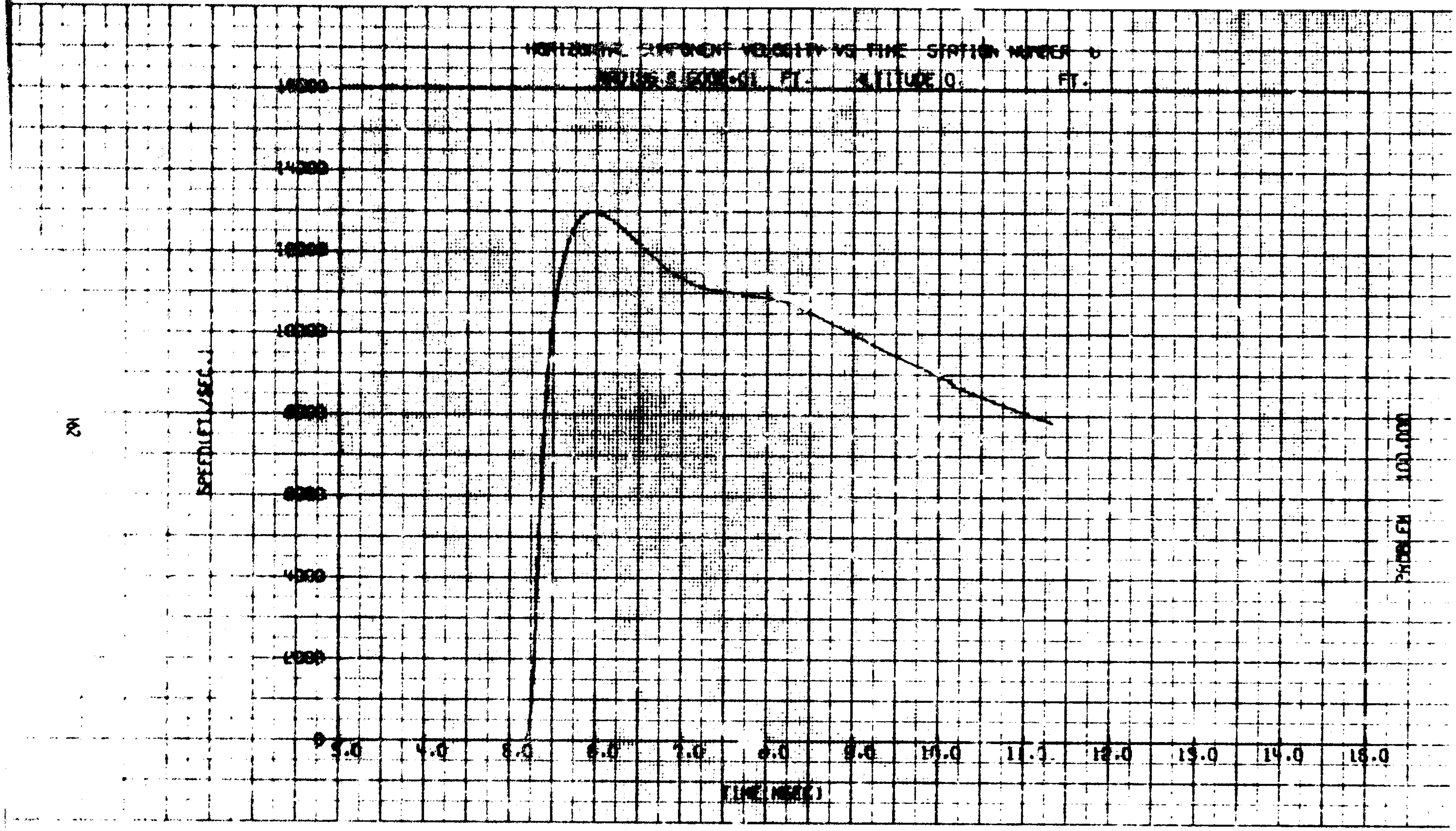

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 5
RADIUS 6.990E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
15000
14000
10000
8000
4000
0
4.0
7.0
8.0
9.0
10.0
13.0
14.0
TIME(MSEC)
PROBLEM 100.000

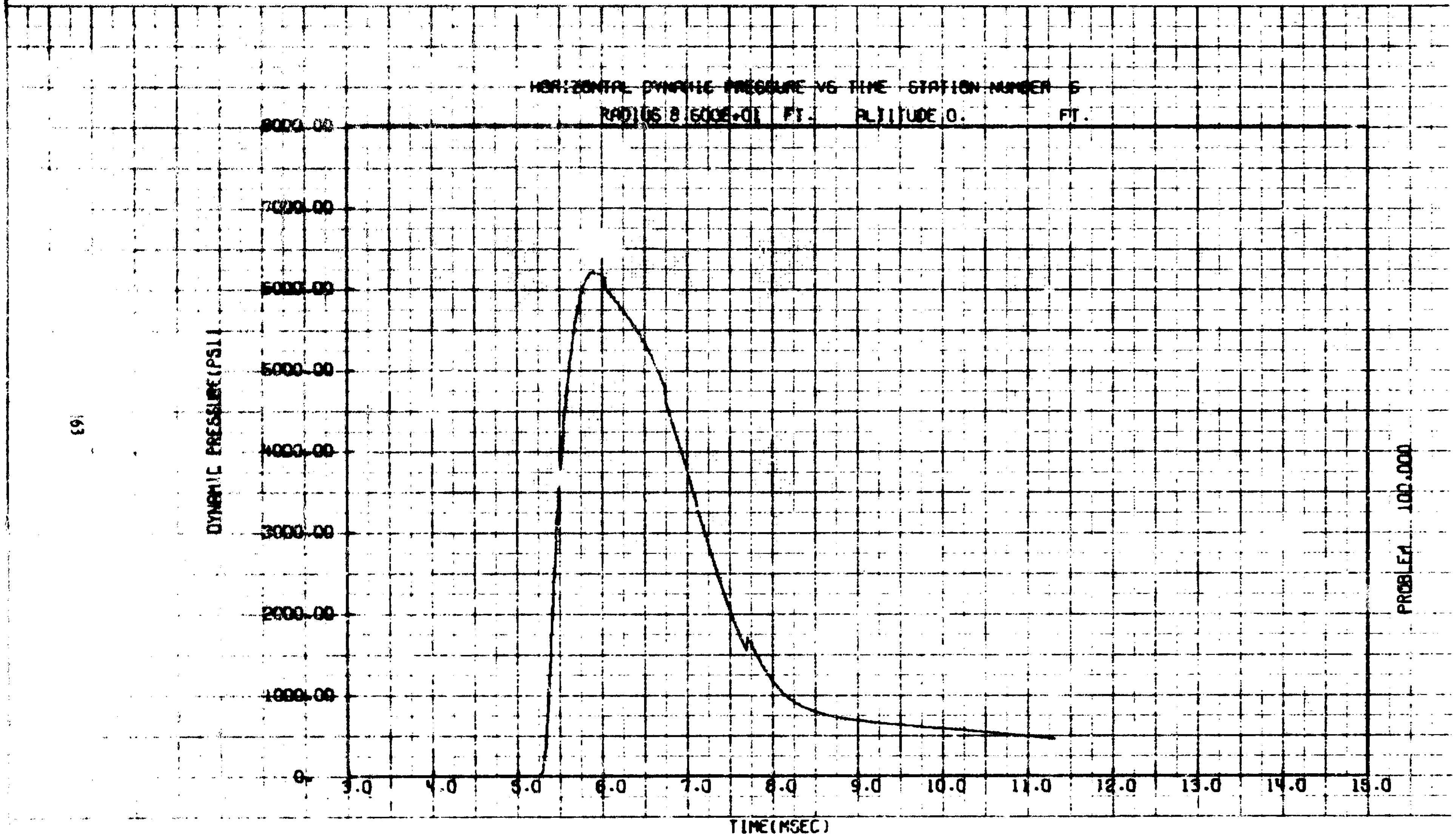

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 5
FT. ALTITUDE 0. FT.
14000
12000
10000
8000
6000
4000
2000
0
-2000
DYNAMIC PRESSURE(PSI)
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)
PROBLEM 100.000


HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 5
RADIUS 6.950E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC..)
28000
24000
20000
16000
12000
8000
4000
0
-4000
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
TIME(MSEC)
PROBLEM 100.000

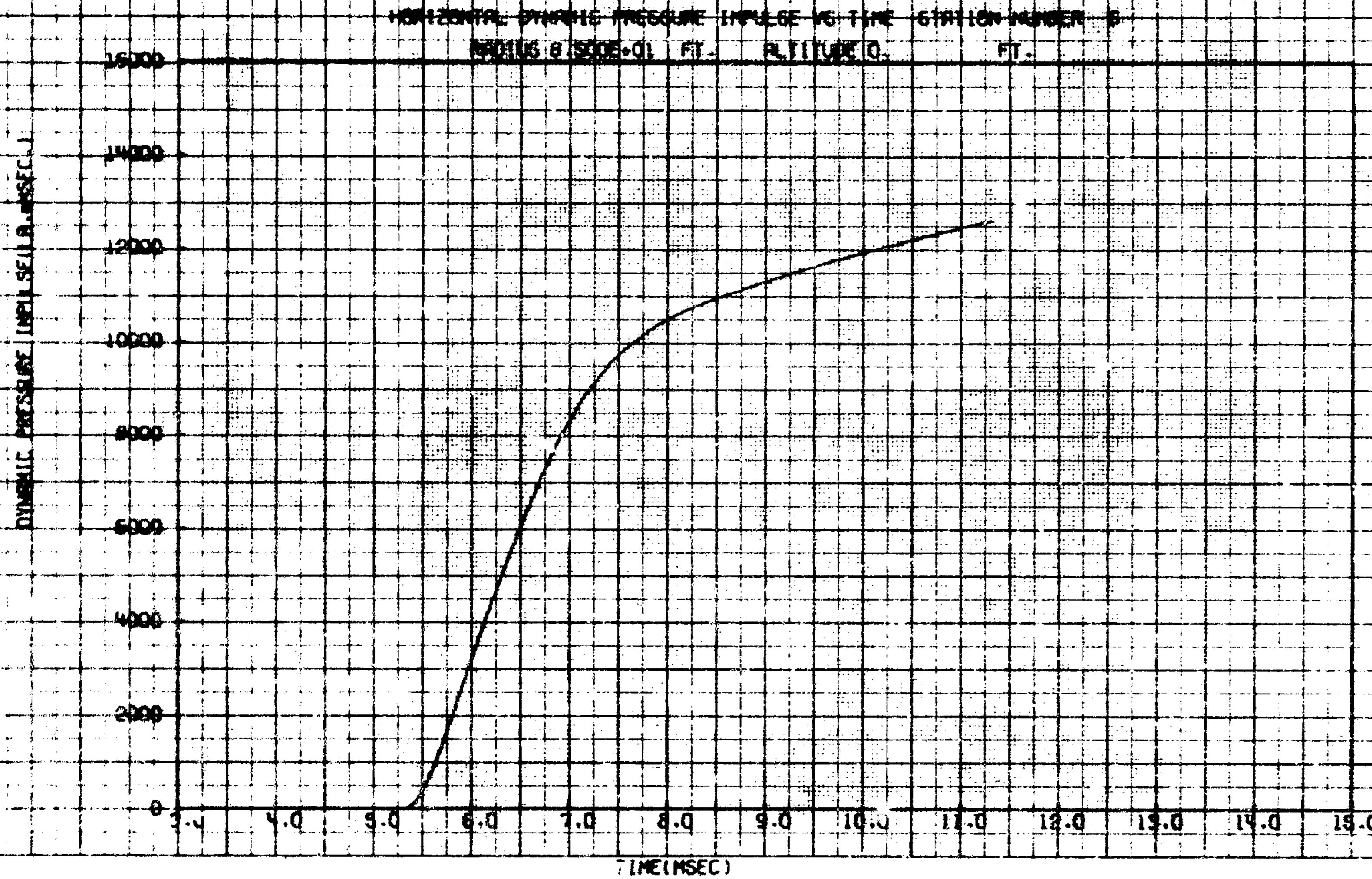

OVER PRESSURE VS TIME STATION NUMBER 6
RADIUS 0.5000E+01 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
TIME(MSEC)
PROBLEM 100.000

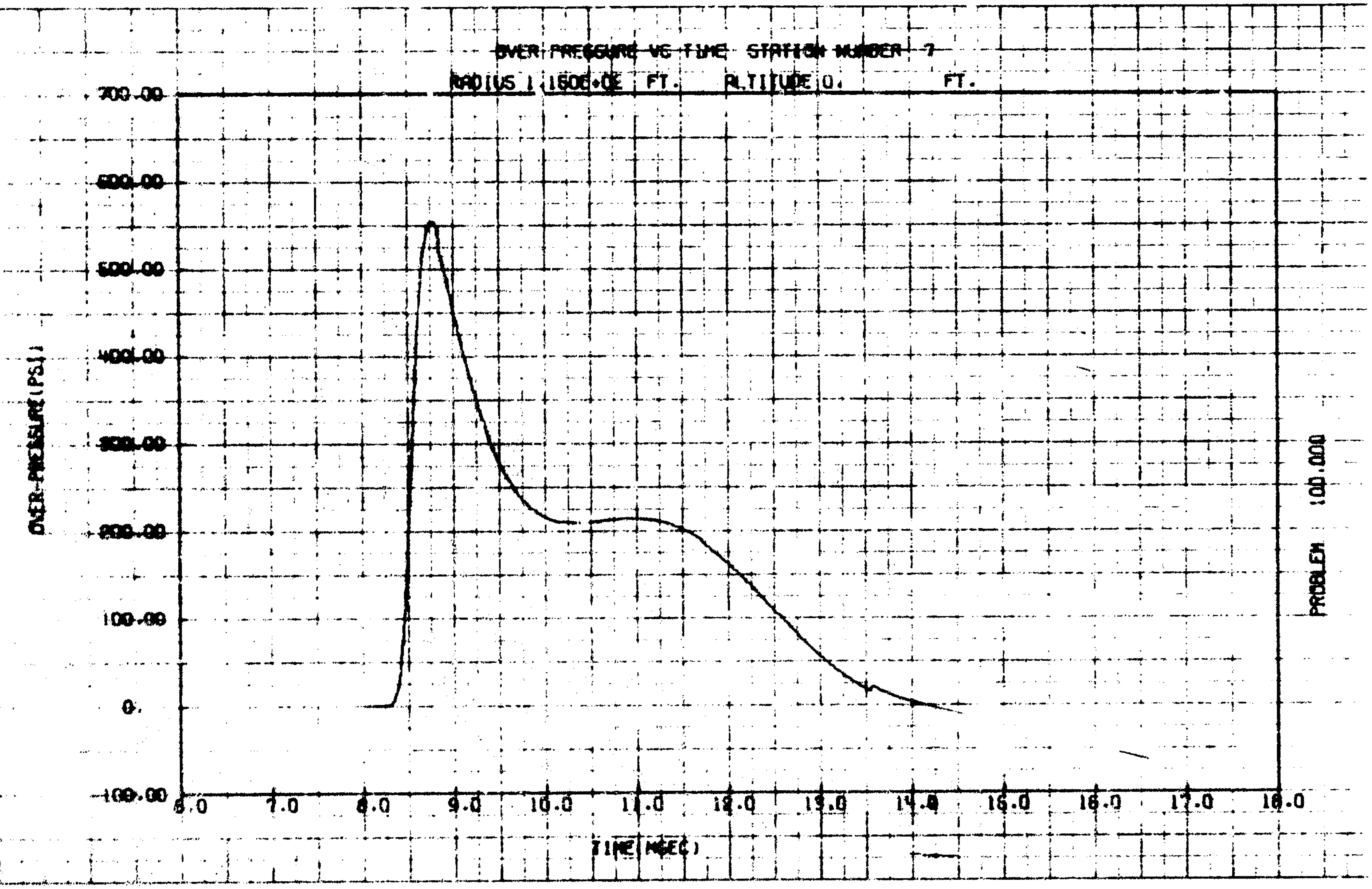

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 6
RADIUS 8.500E+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB-MSEC.)
TIME(MSEC)
PROBLEM 100.000
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-400.00
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0

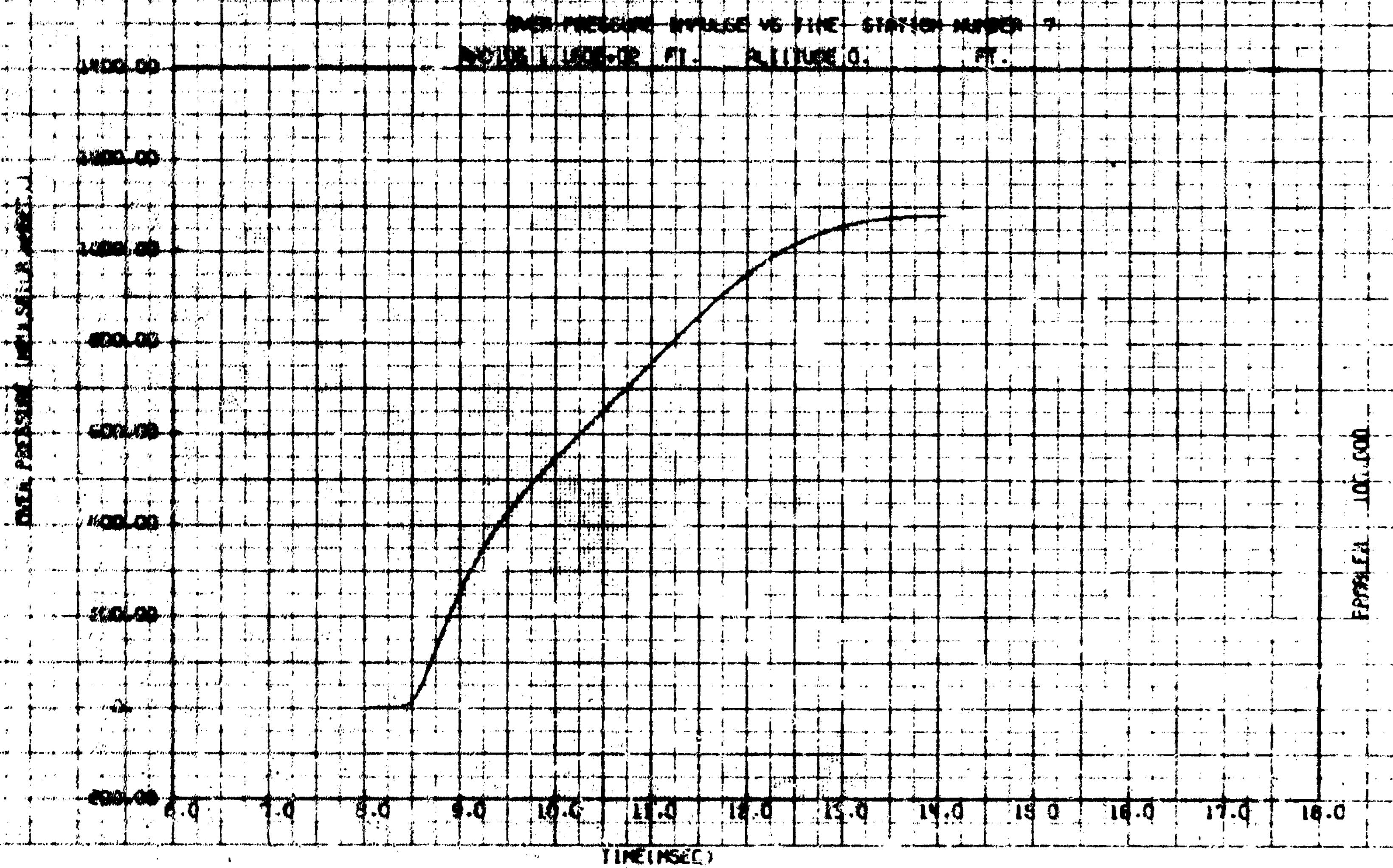

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER
FT.
ALTITUDE 0.
FT.
16000
14000
12000
10000
8000
6000
4000
2000
0
SPEED(FT/SEC)
TIME(MSEC)
PROBLEM 100.000

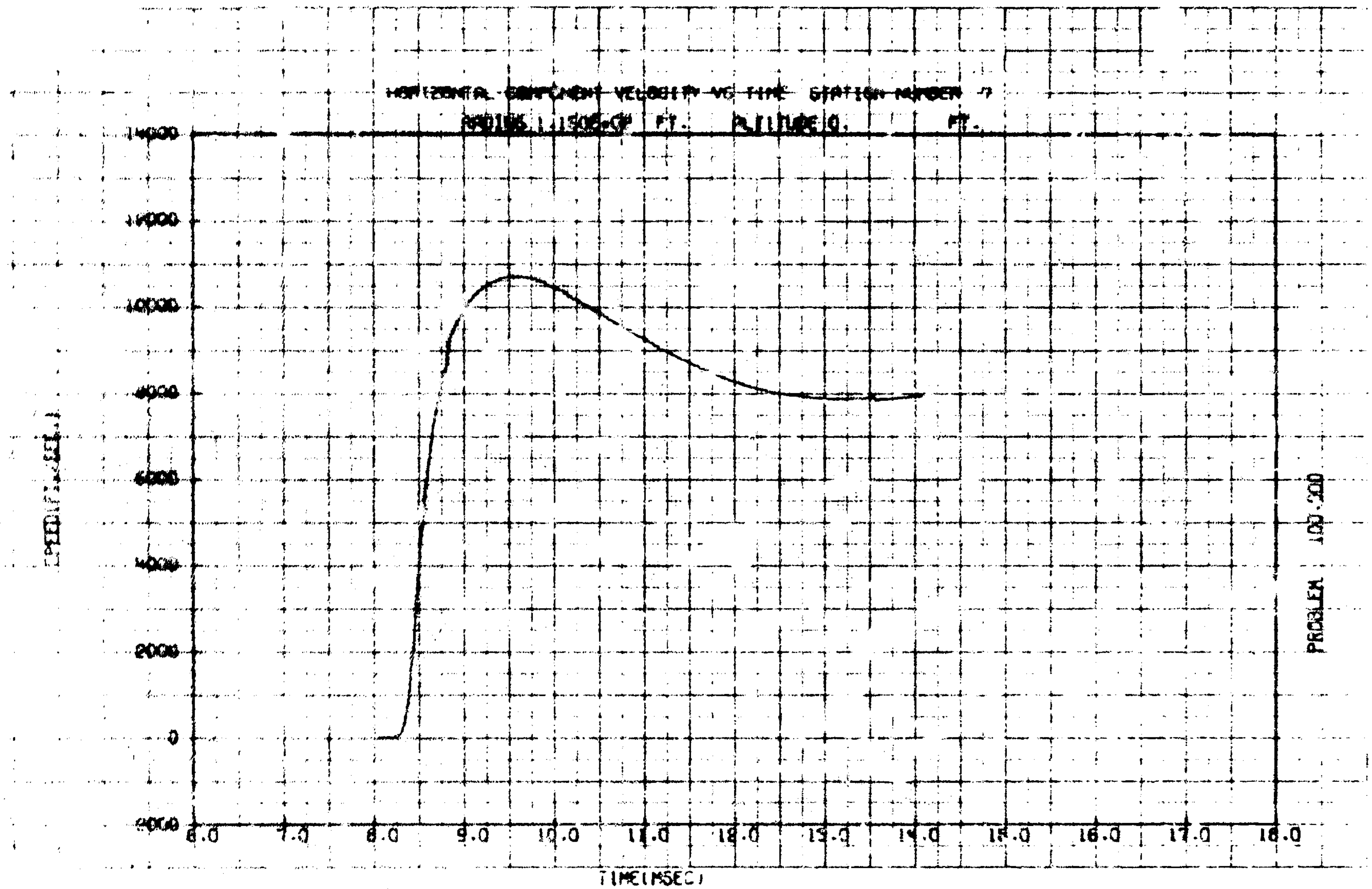


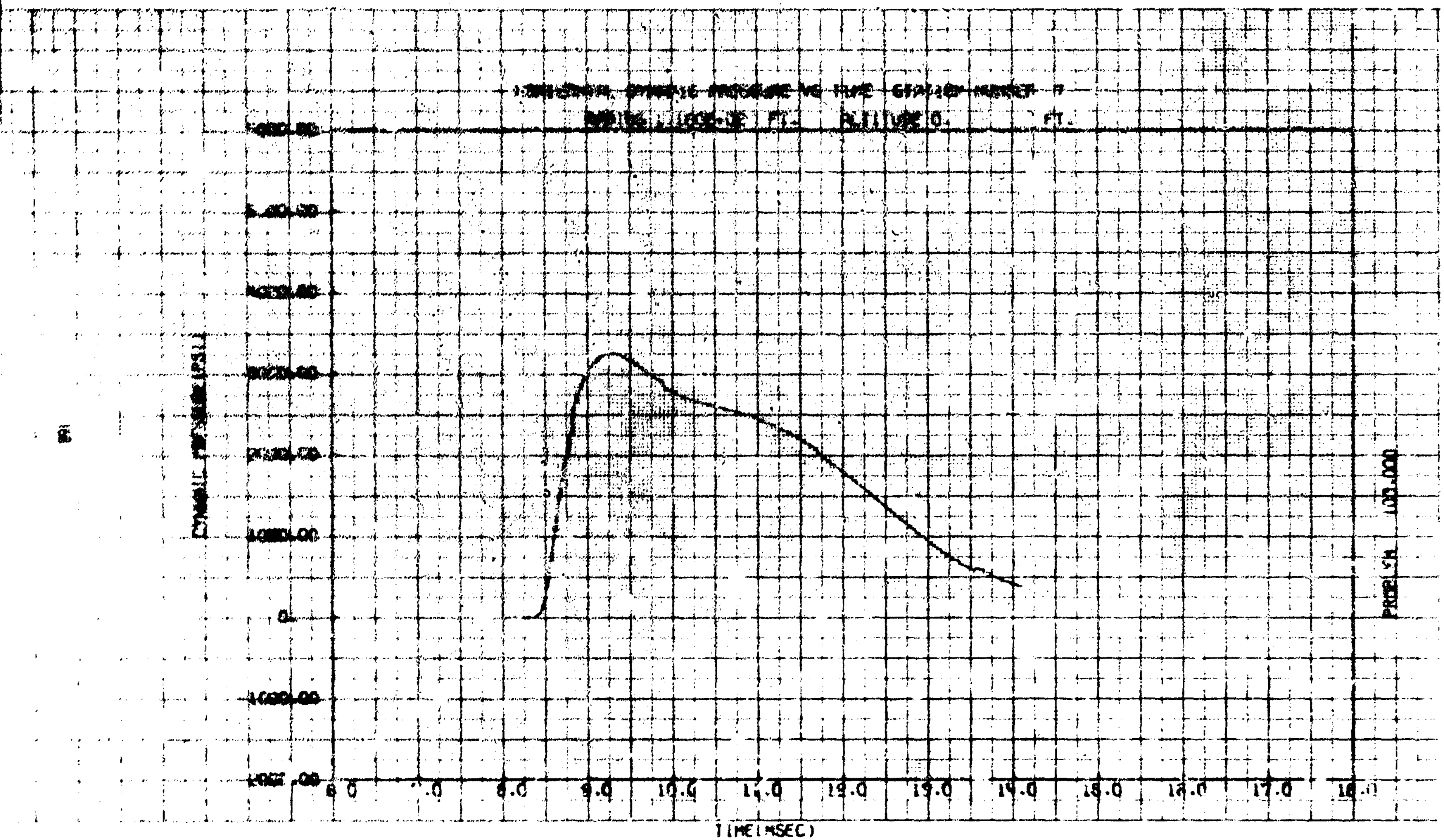
HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 5
RADIUS 8.600E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
TIME(MSEC)
PROBLEM 100.000


HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 8
RADIUS 8.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
16000
14000
12000
10000
8000
6000
4000
2000
0
3.4
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
TIME(MSEC)
PROBLEM 100.000

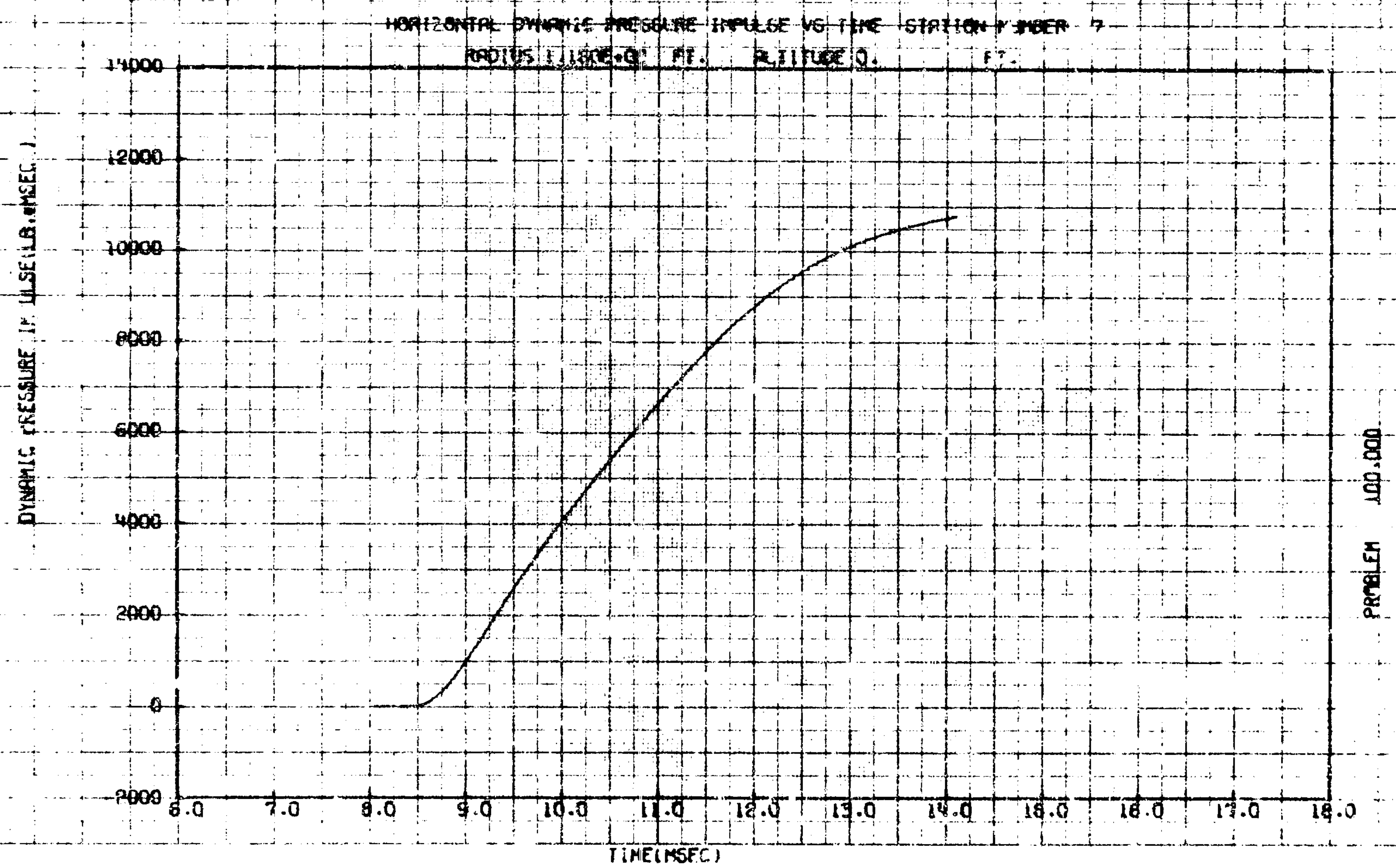

OVER PRESSURE VS TIME STATION NUMBER 7
RADIUS 1.150E+02 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.
-100.00
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 7
RADIUS 1.100E+02 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE (PSI-MSEC)
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
-200.00
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
TIME(MSEC)
EPSILON 100.000

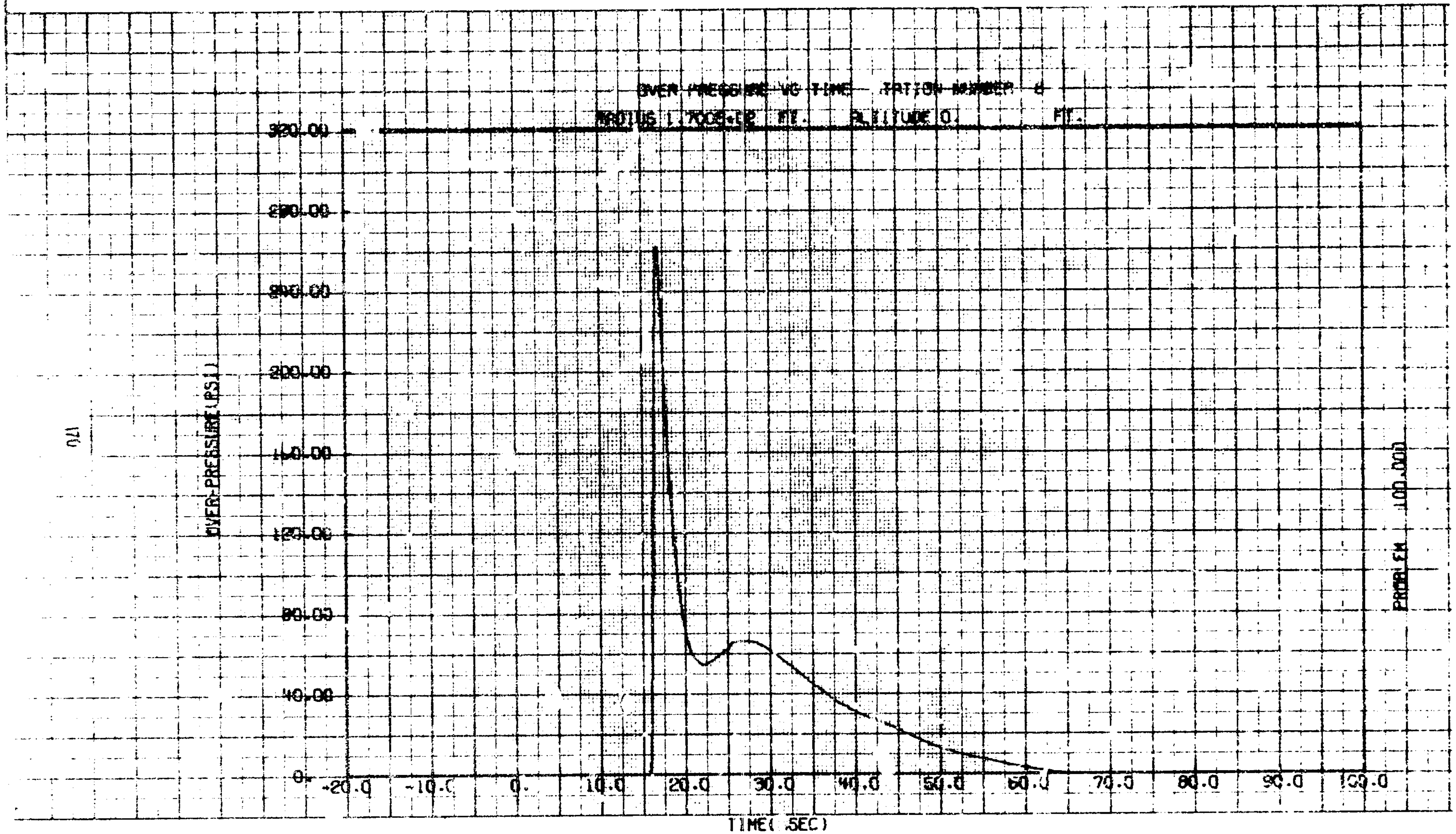

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 7
14000
12000
10000
8000
6000
4000
2000
0
-2000
SPEED(FT/SEC)
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
TIME(MSEC)
PROBLEM 100.000

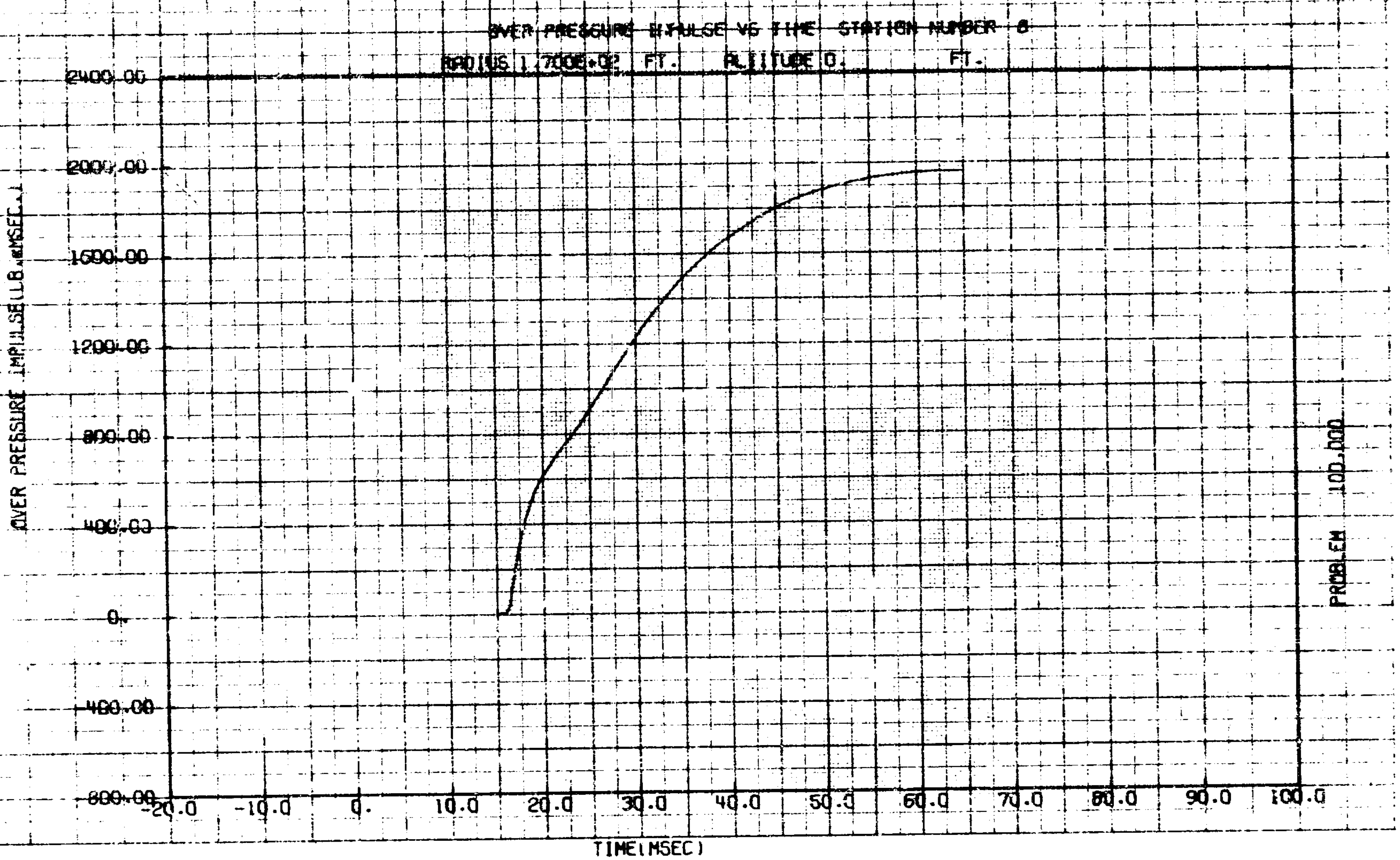


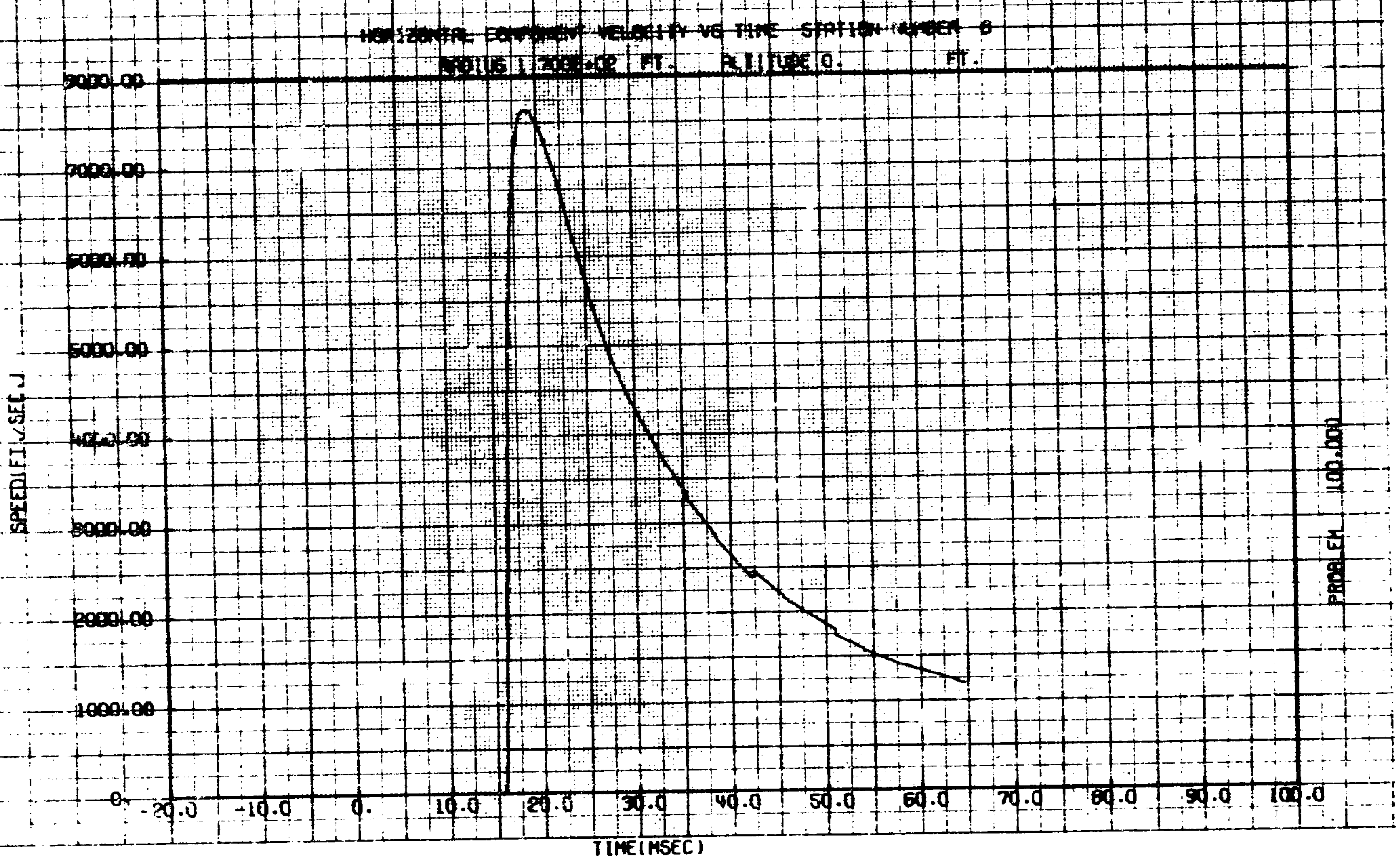
TIME(MSEC)
PROBLEM 100.000

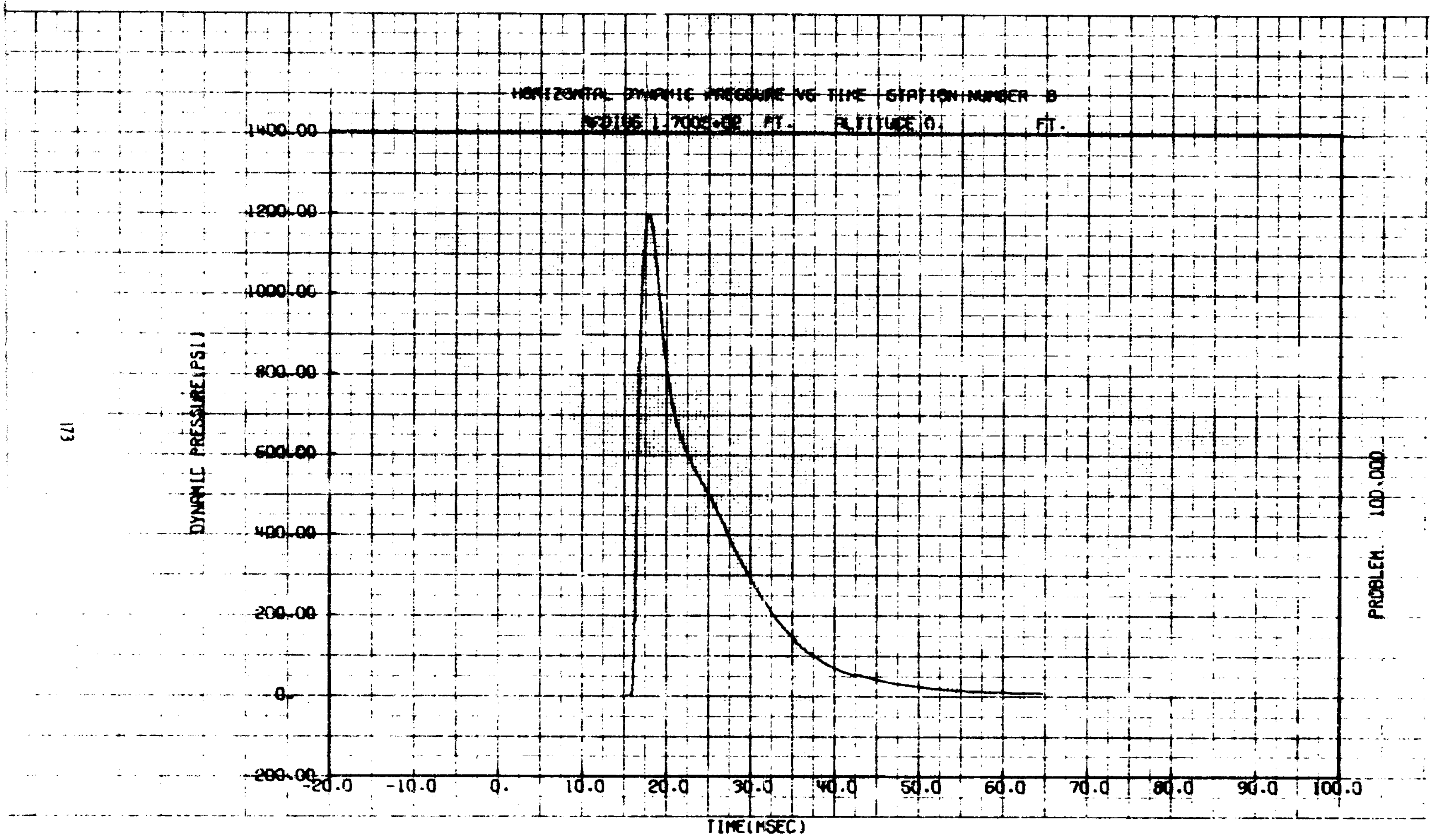


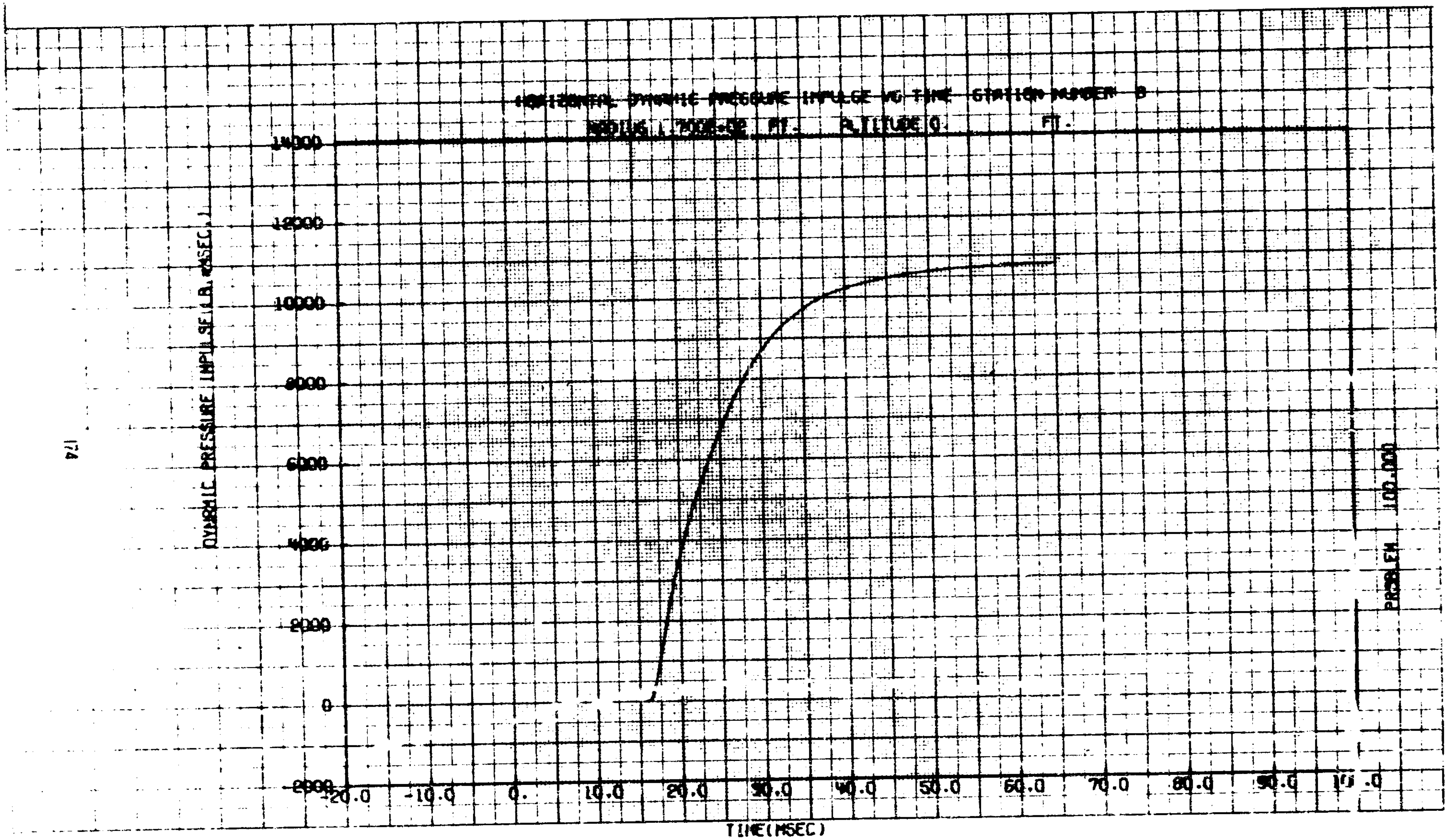
HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 7
RADIUS FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
14000
12000
10000
8000
6000
4000
2000
0
-2000
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
TIME(MSEC)
PROBLEM 100.000

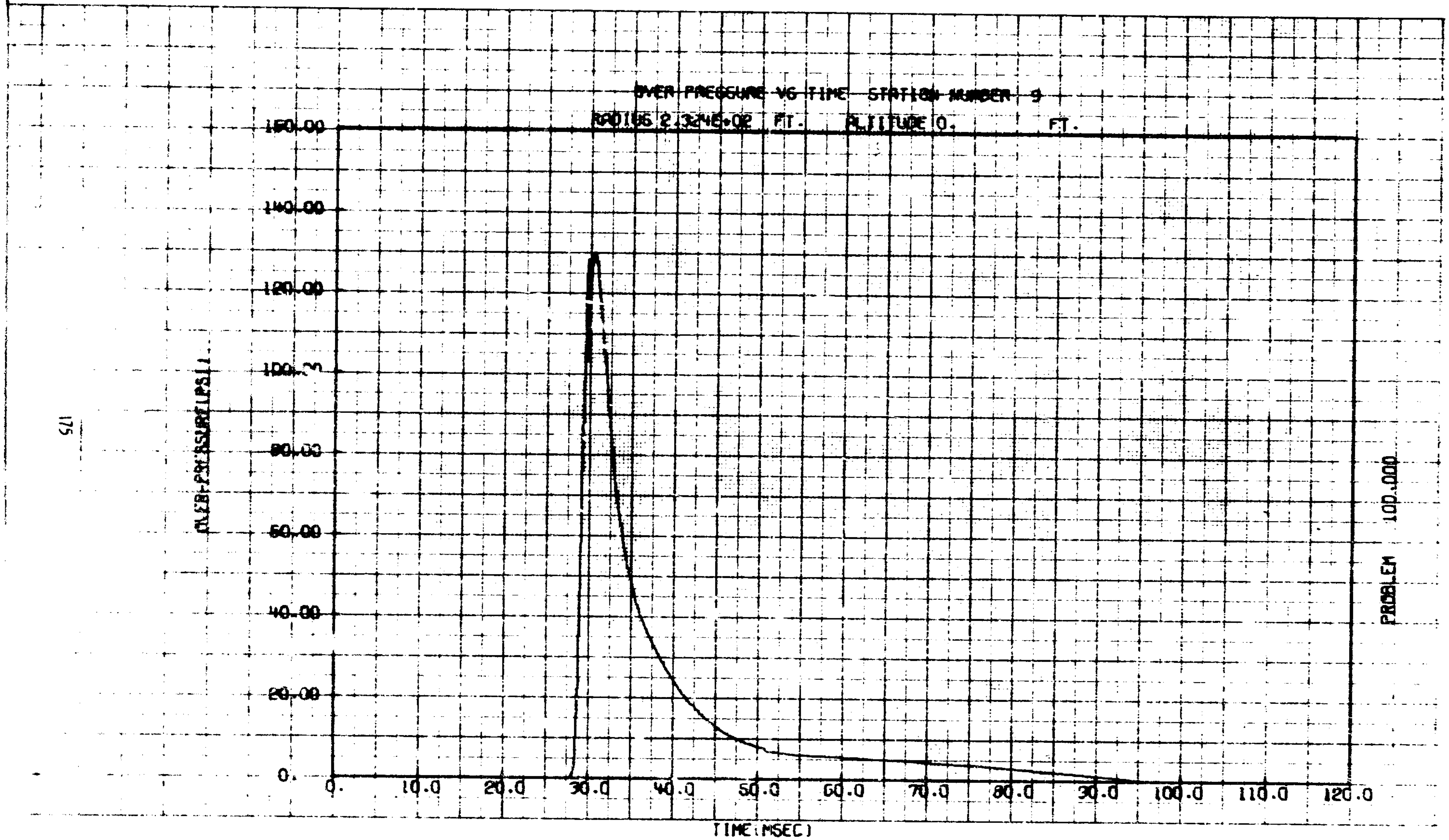

OVER PRESSURE VS TIME
RADIUS 1.700E+02 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
TIME(SEC)
PROBLEM 100.000
320.00
280.00
240.00
200.00
160.00
120.00
80.00
40.00
0.
-20.0
-10.0
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 8
RADIUS 1.7000E+02 FT. ALTITUDE 0. FT.
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-800.00
OVER PRESSURE IMPULSE(LB.*MSEC.)
-20.0
-10.0
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
TIME(MSEC)
PROBLEM 100.000

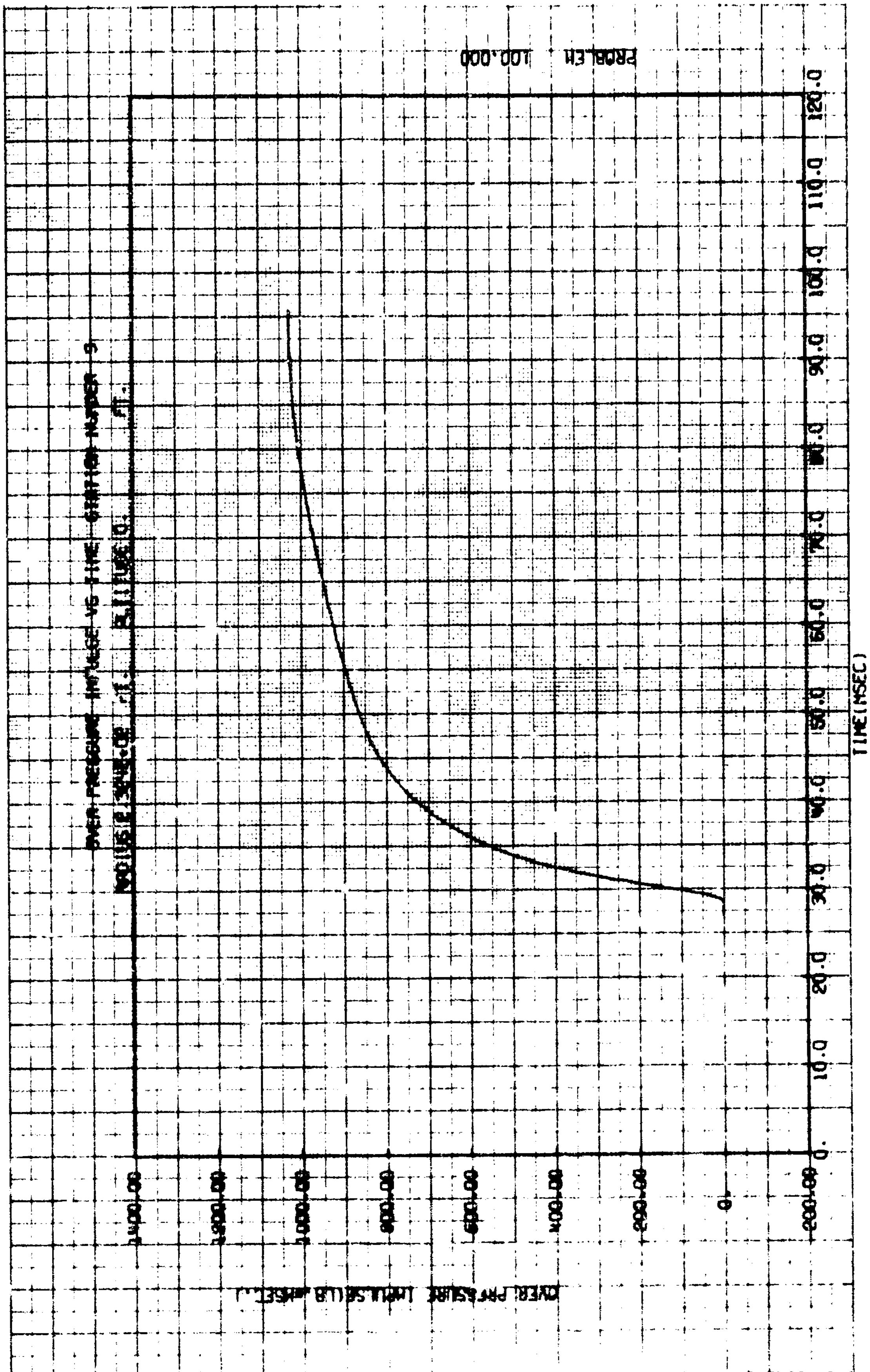

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 8
RADIUS FT. ALTITUDE 0. FT.
SPEED(FT/SEC)
9000.00
7000.00
6000.00
5000.00
3000.00
2000.00
1000.00
0.
-20.0
-10.0
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
TIME(MSEC)
PROBLEM 100.000

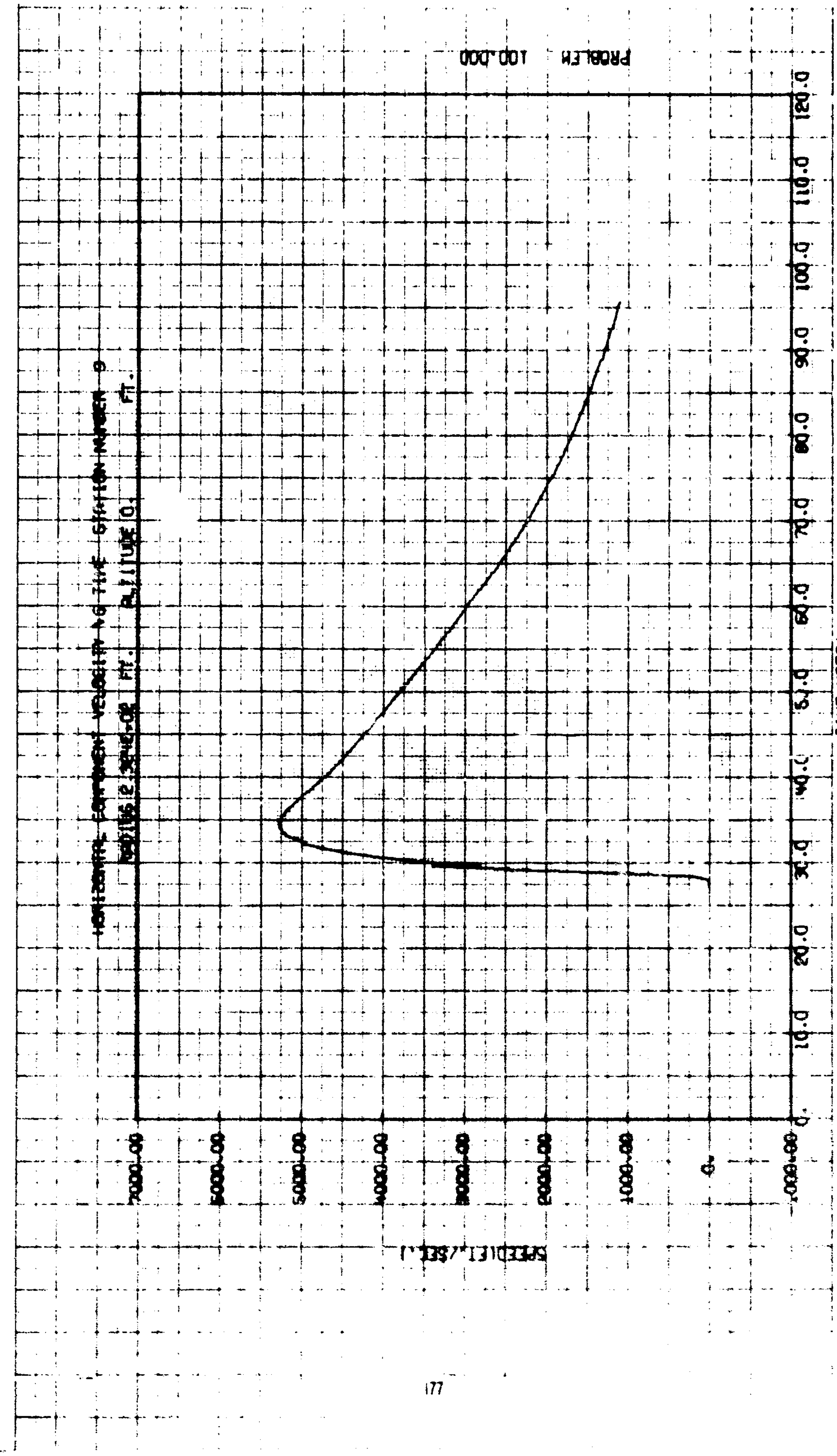

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 8
RADIUS 1.700E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-20.0
-10.0
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
TIME(MSEC)
PROBLEM 100.000


HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 8
RADIUS 1.700E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE (LB.-MSEC.)
14000
12000
10000
8000
6000
4000
2000
0
-2000
-20.0
-10.0
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
TIME(MSEC)
PROBLEM 100.000

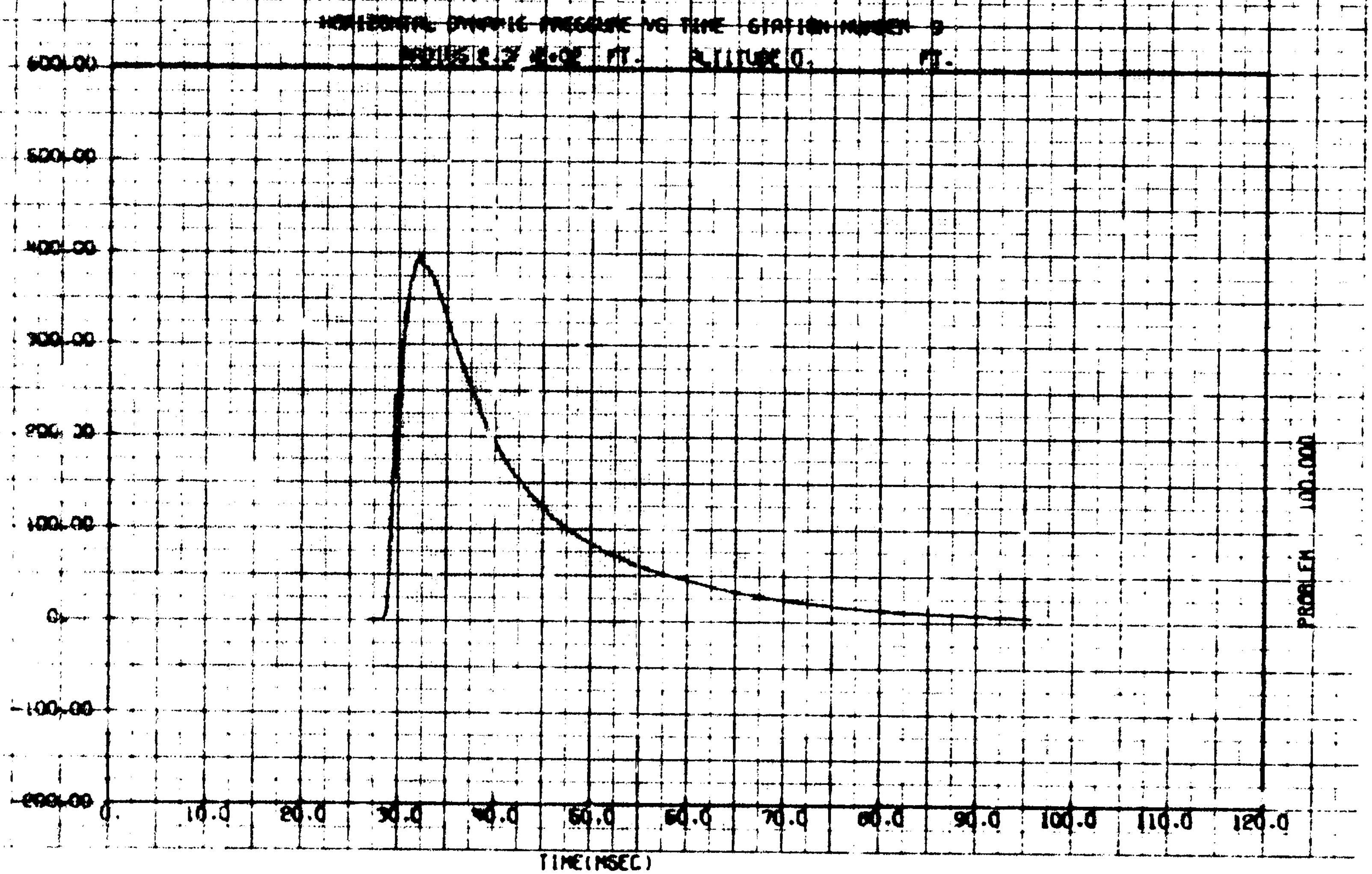


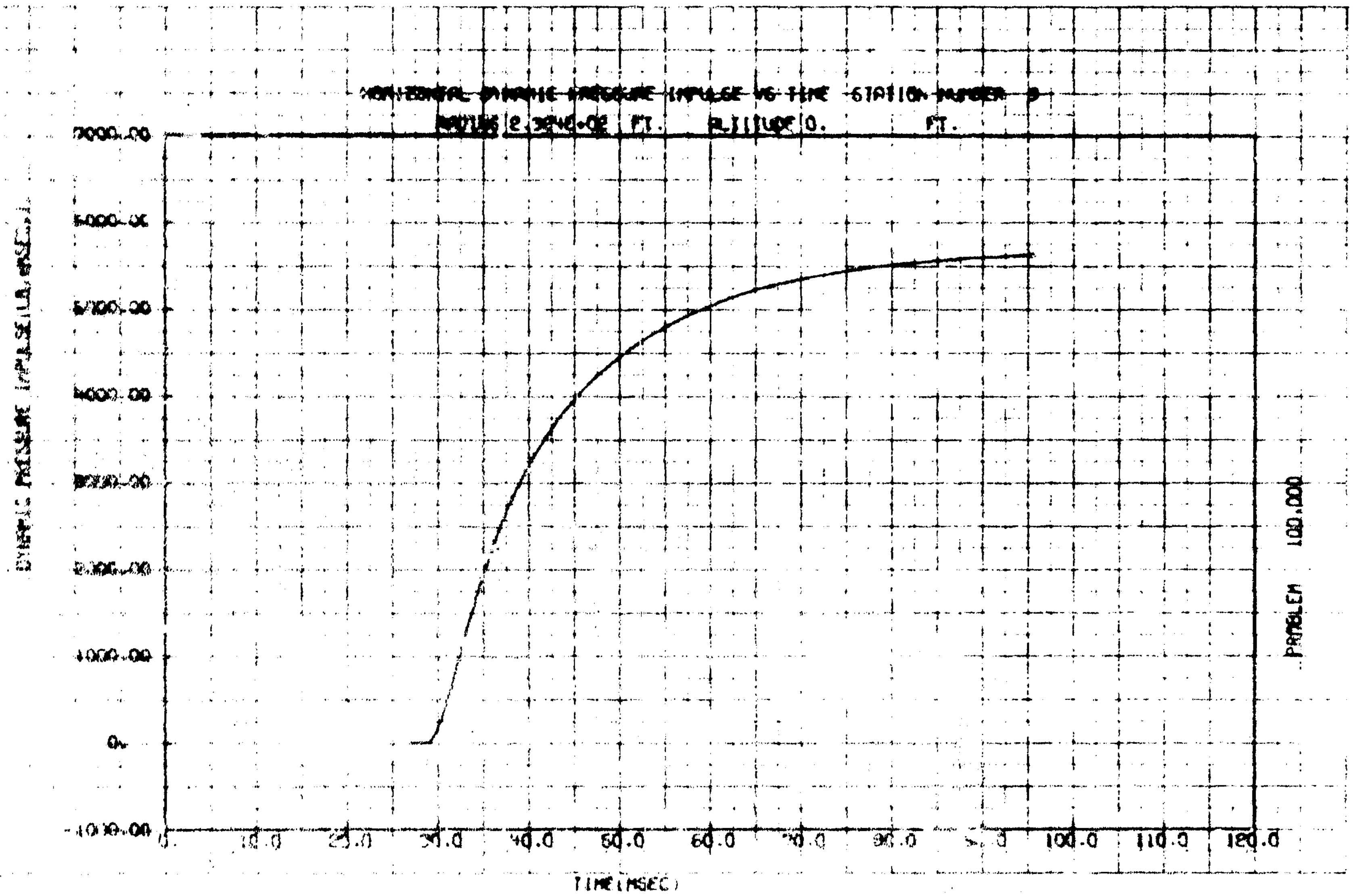
OVER PRESSURE VS TIME   STATION NUMBER 9
RADIUS 2.324E+02 FT.   ALTITUDE 0.   FT.
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.
OVER-PRESSURE(PSI)
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
TIME(MSEC)
PROBLEM 100.000


OVER-PRESSURE IMPULSE VS TIME STATION NUMBER 9
TIME(MSEC)
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
-200.00
0.
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
PROBLEM 100.000

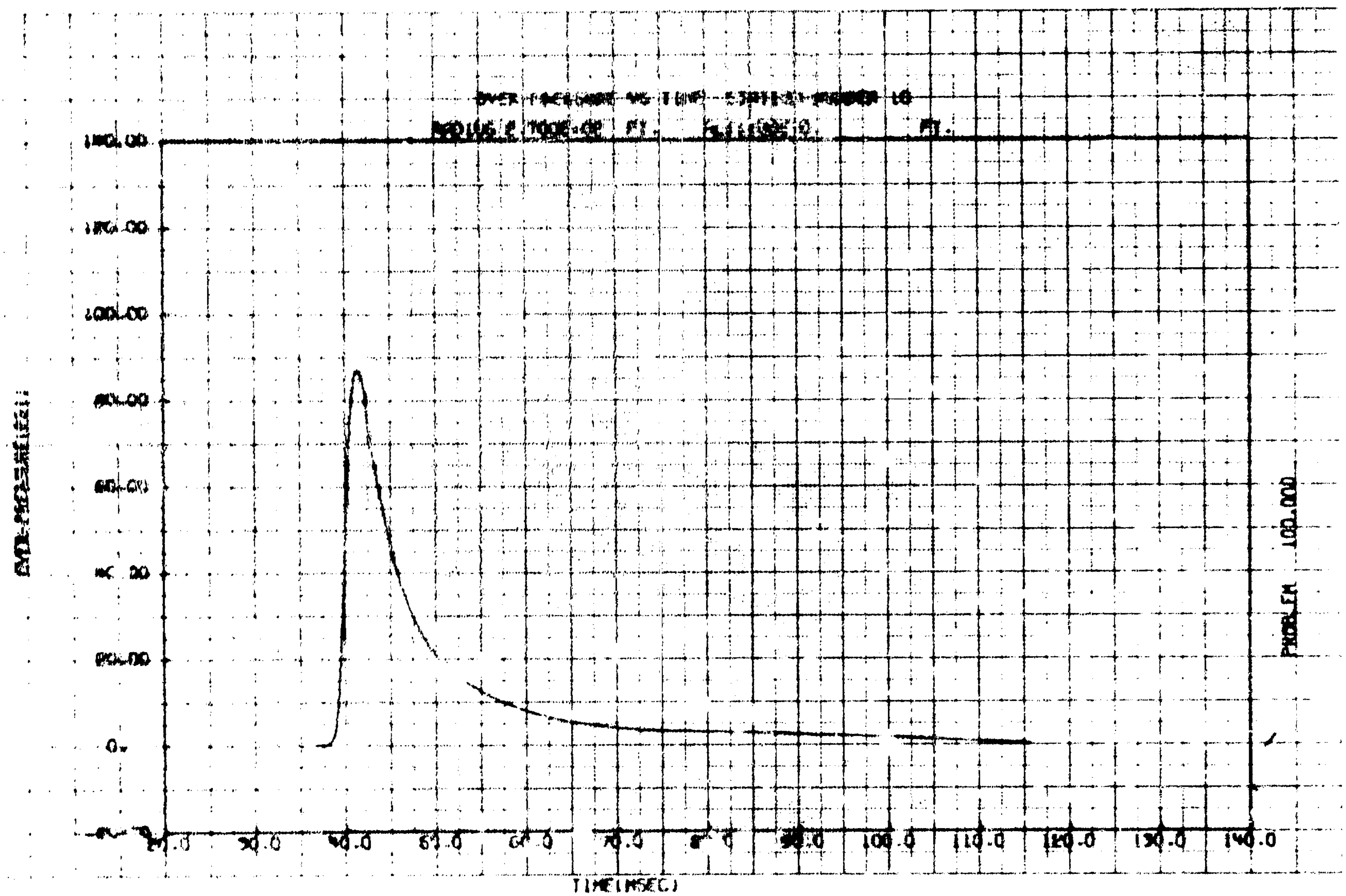


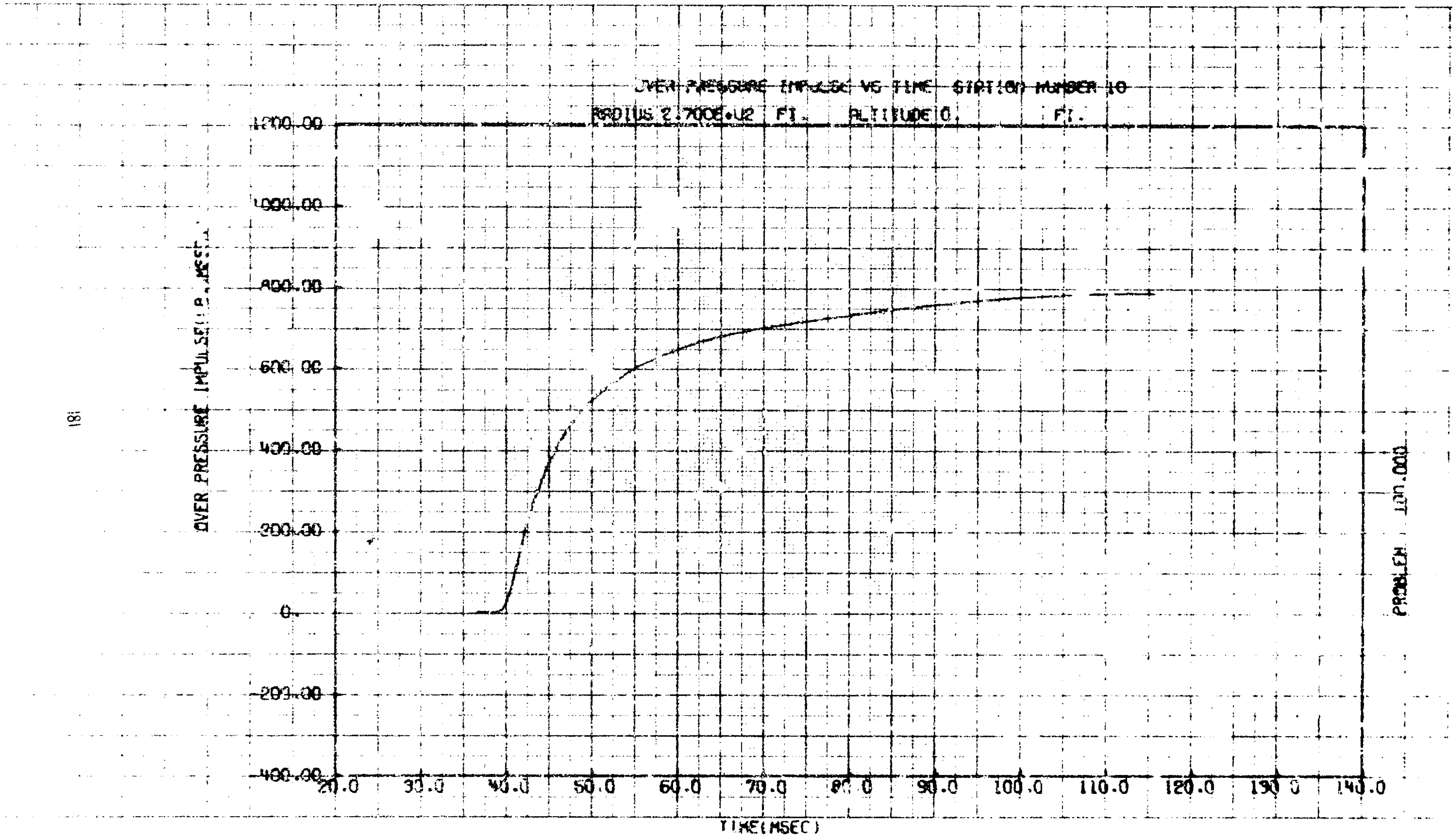
HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 9
ALTITUDE 0. FT.
PROBLEM 100.000
TIME (MSEC)
SPEED(FT./SEC.)
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
-1000.00

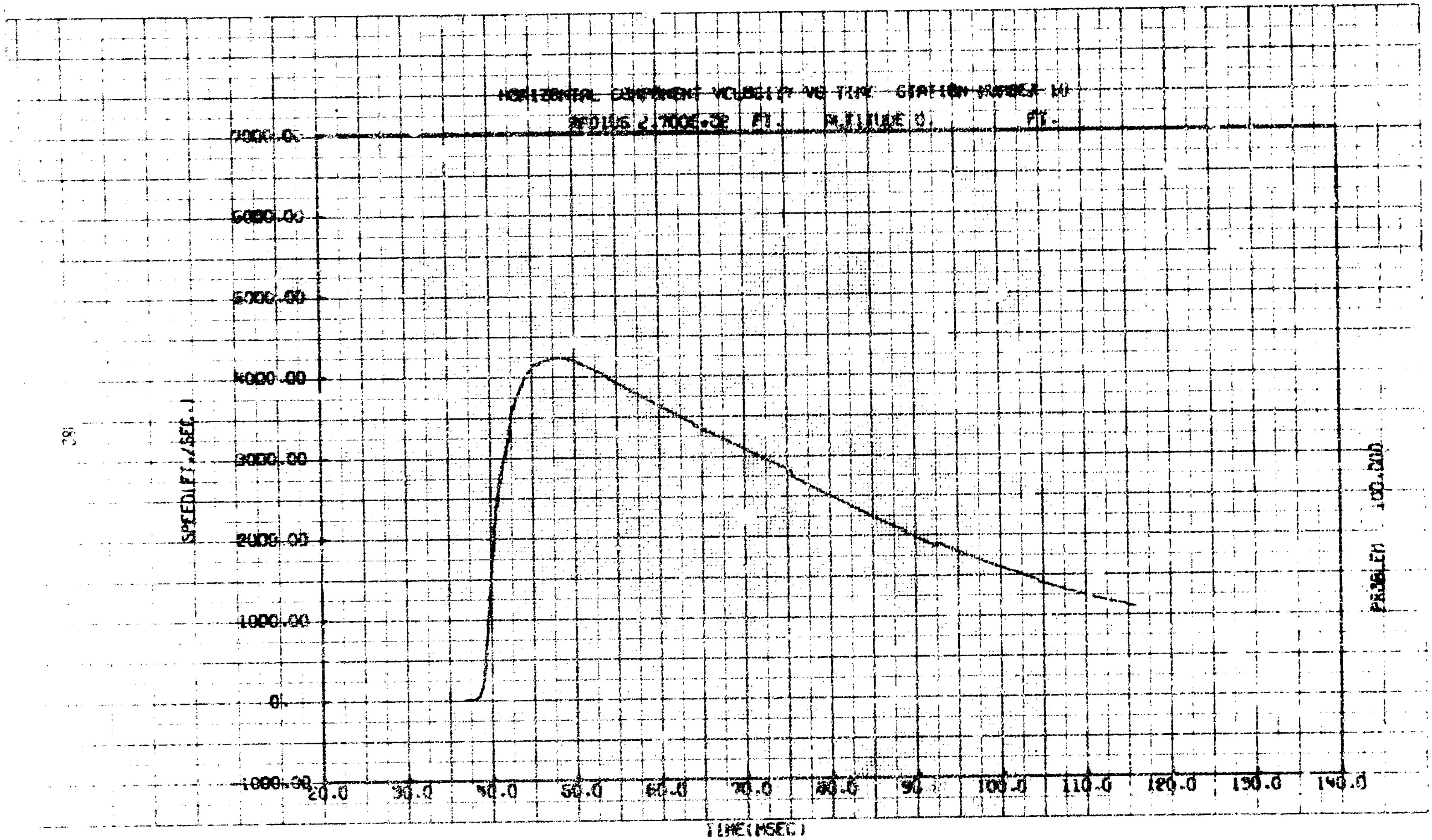

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 9
ALTITUDE 0. FT.
600.00
500.00
400.00
300.00
200.00
100.00
0.
-100.00
-200.00
DYNAMIC PRESSURE(PSI)
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
TIME(MSEC)
PROBLEM 100.000

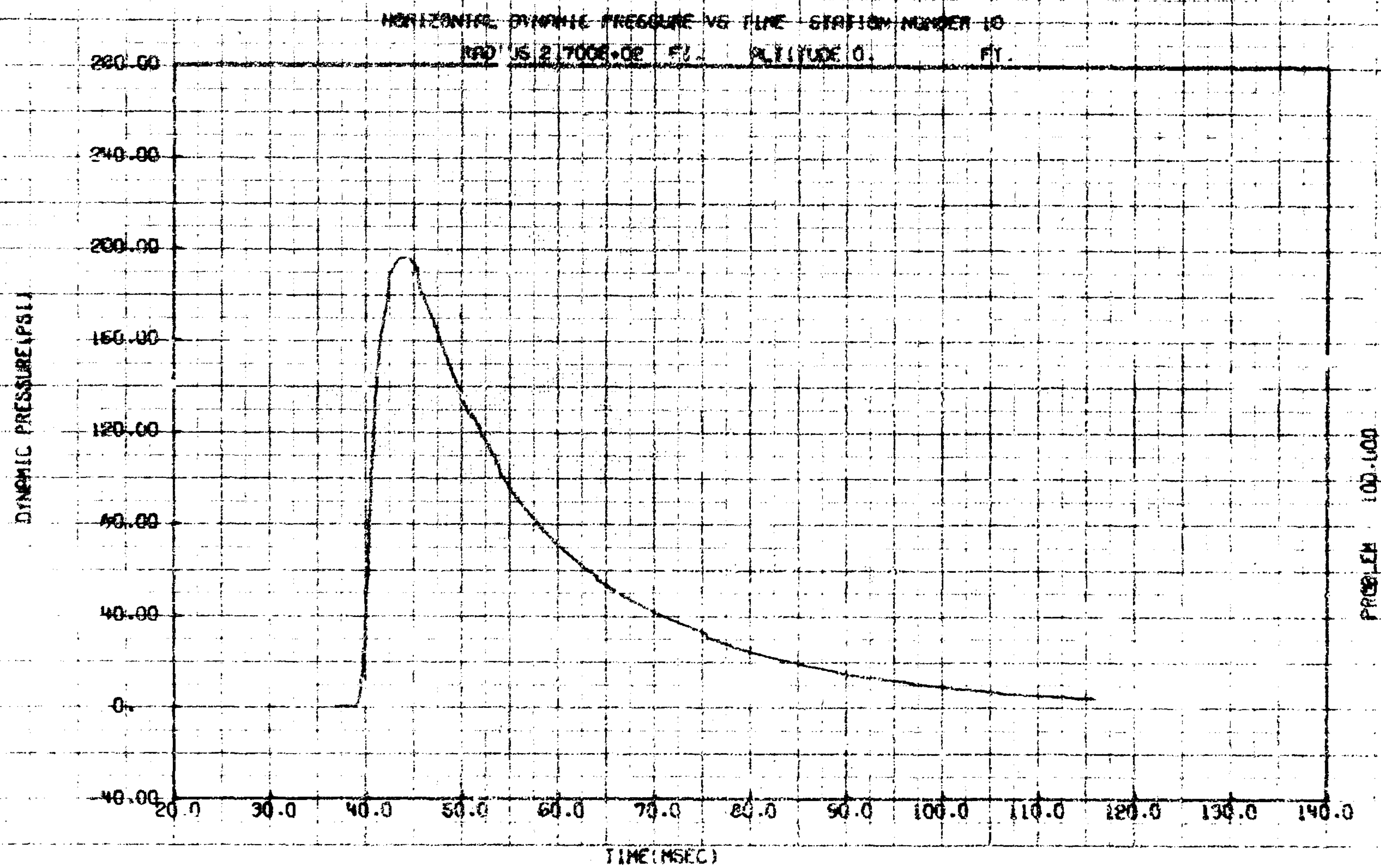


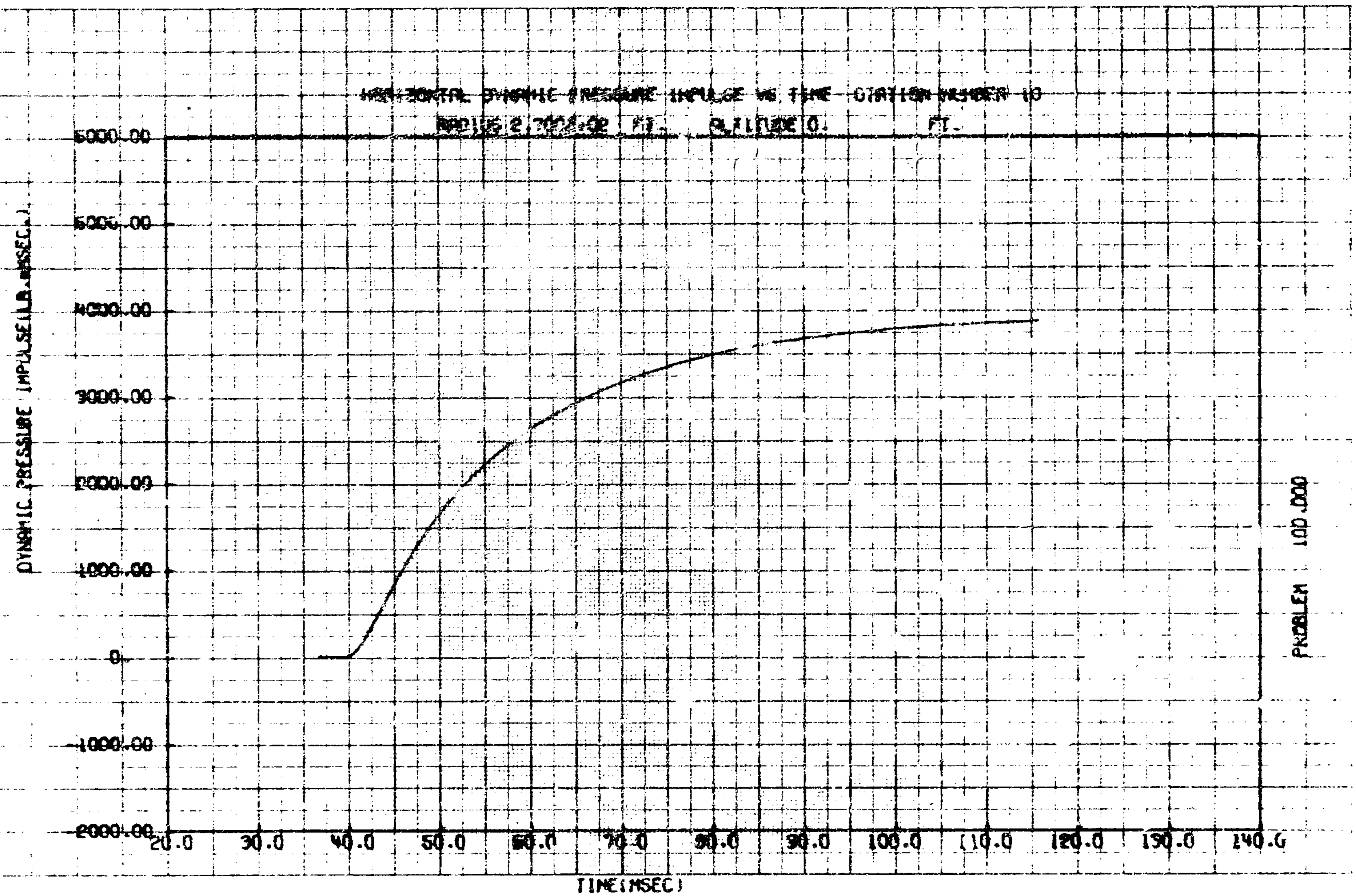
HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 9
RADIUS
FT.
ALTITUDE 0.
FT.
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
0.
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
TIME(MSEC)
DYNAMIC PRESSURE IMPULSE
PROBLEM 100.000

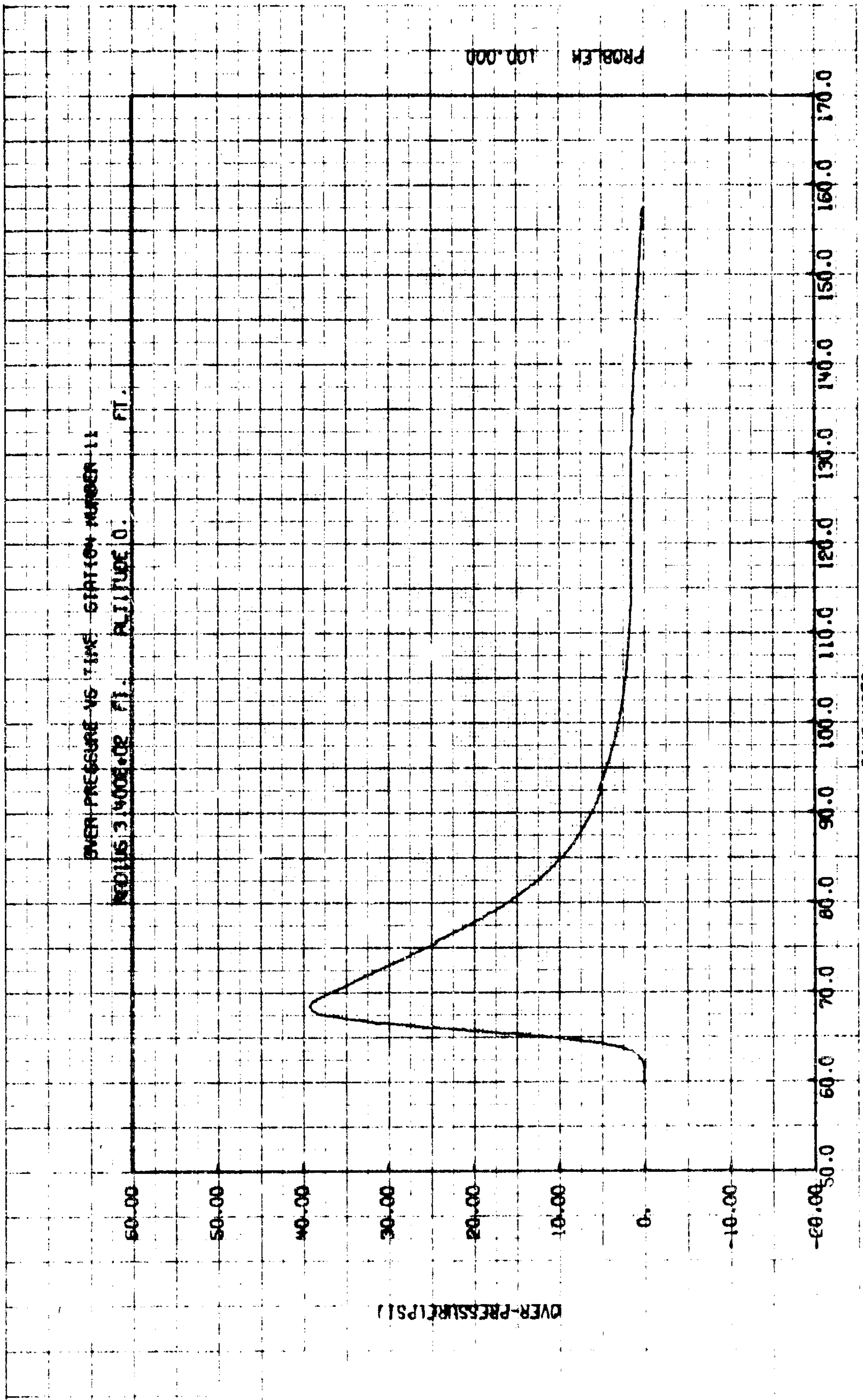

PROBLEM 100.000
TIME(MSEC)
100.0
110.0
130.0
140.0

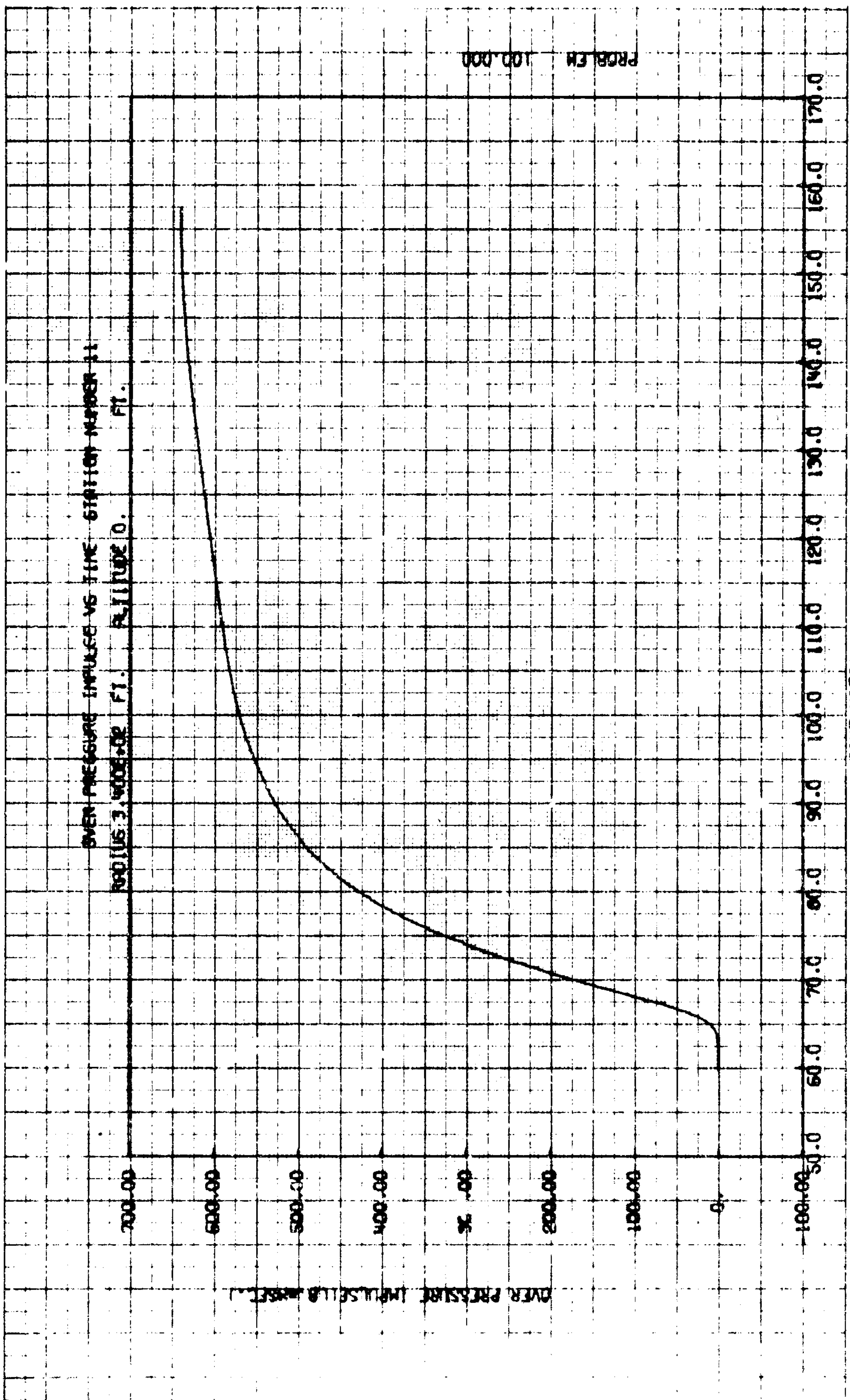

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 10
RADIUS 2.700E+02 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(P-MSEC)
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-400.00
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
TIME(MSEC)
PROBLEM 100.000

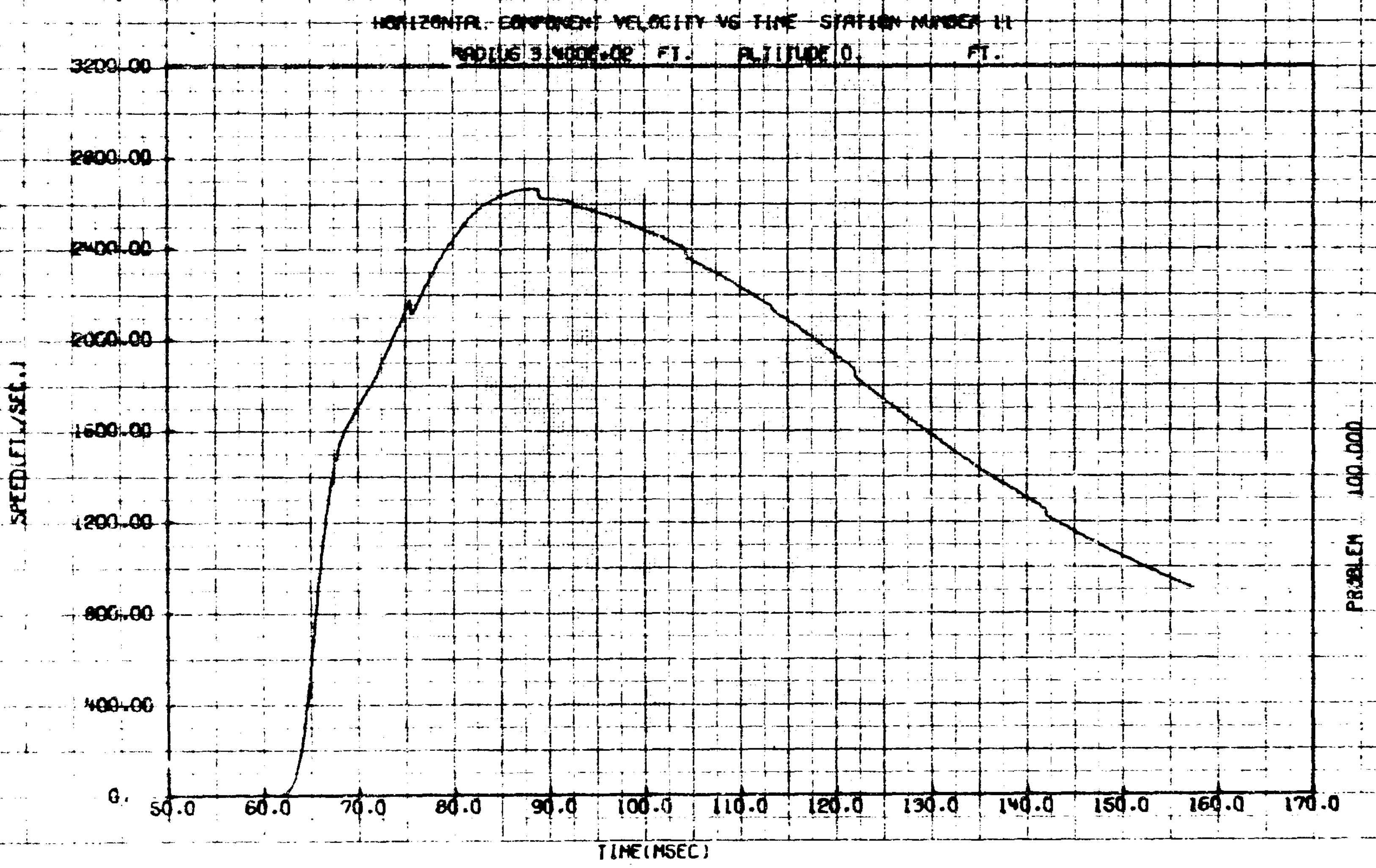

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 10
RADIUS 2.7000E+02 FT. ALTITUDE 0. FT.
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
SPEED(FT./SEC.)
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
TIME(MSEC)
PROBLEM 100.000

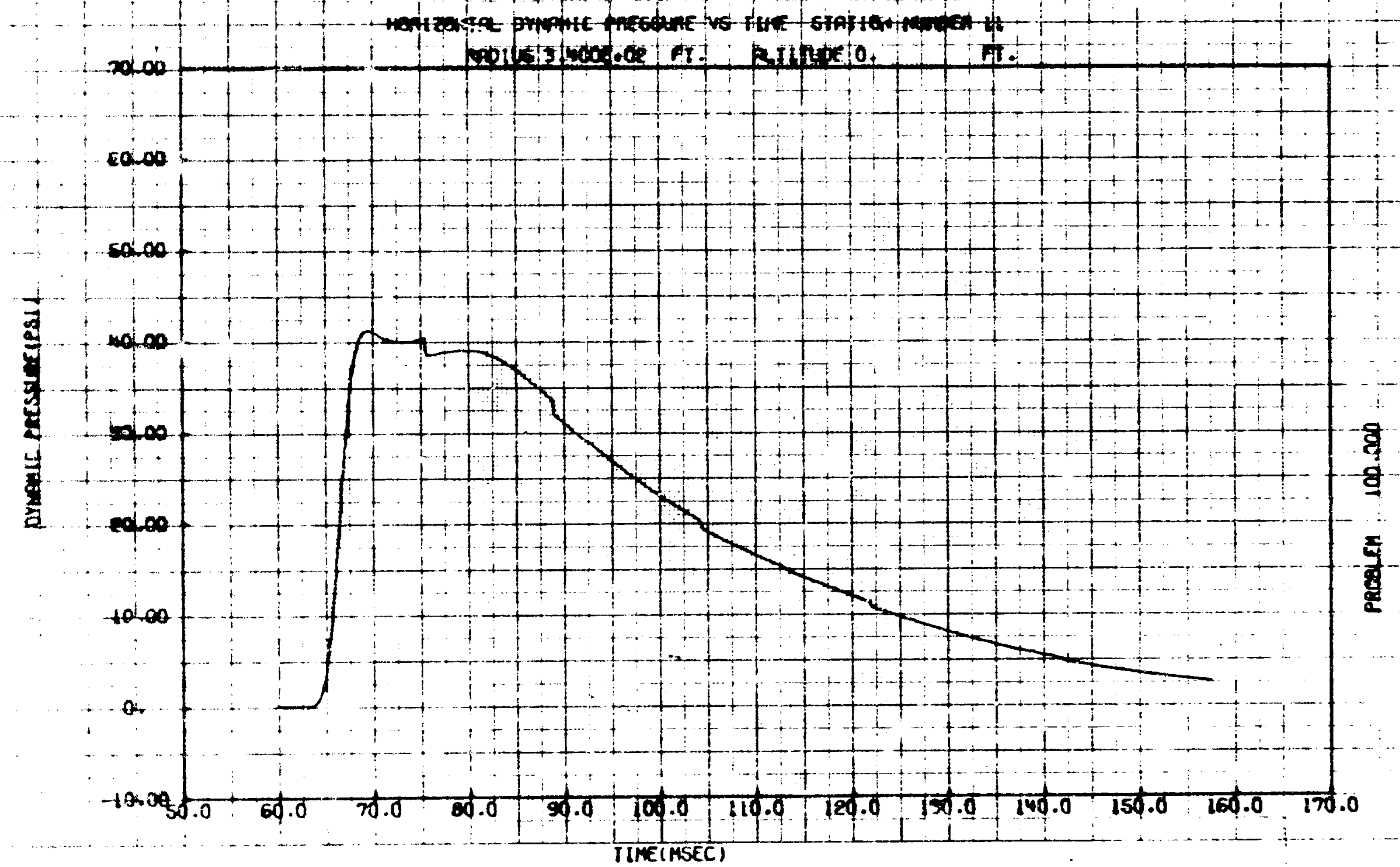

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 10
RAD US 2.1700E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
280.00
240.00
200.00
160.00
120.00
80.00
40.00
0.
-40.00
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
TIME(MSEC)
PROBLEM 100.000

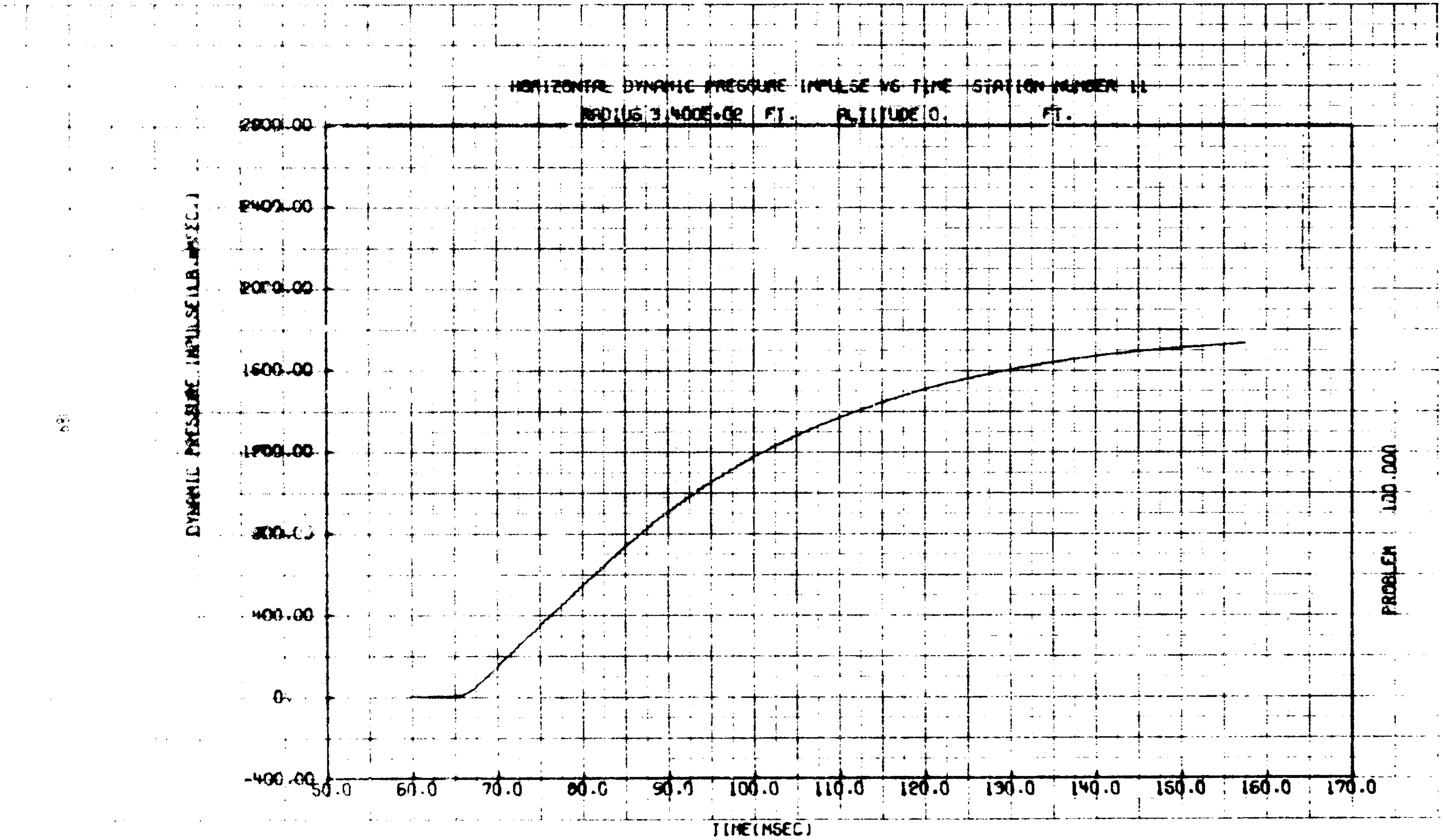

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 10
ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB-MSEC.)
7000.00
6000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
-2000.00
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
TIME(MSEC)
PROBLEM 100.000

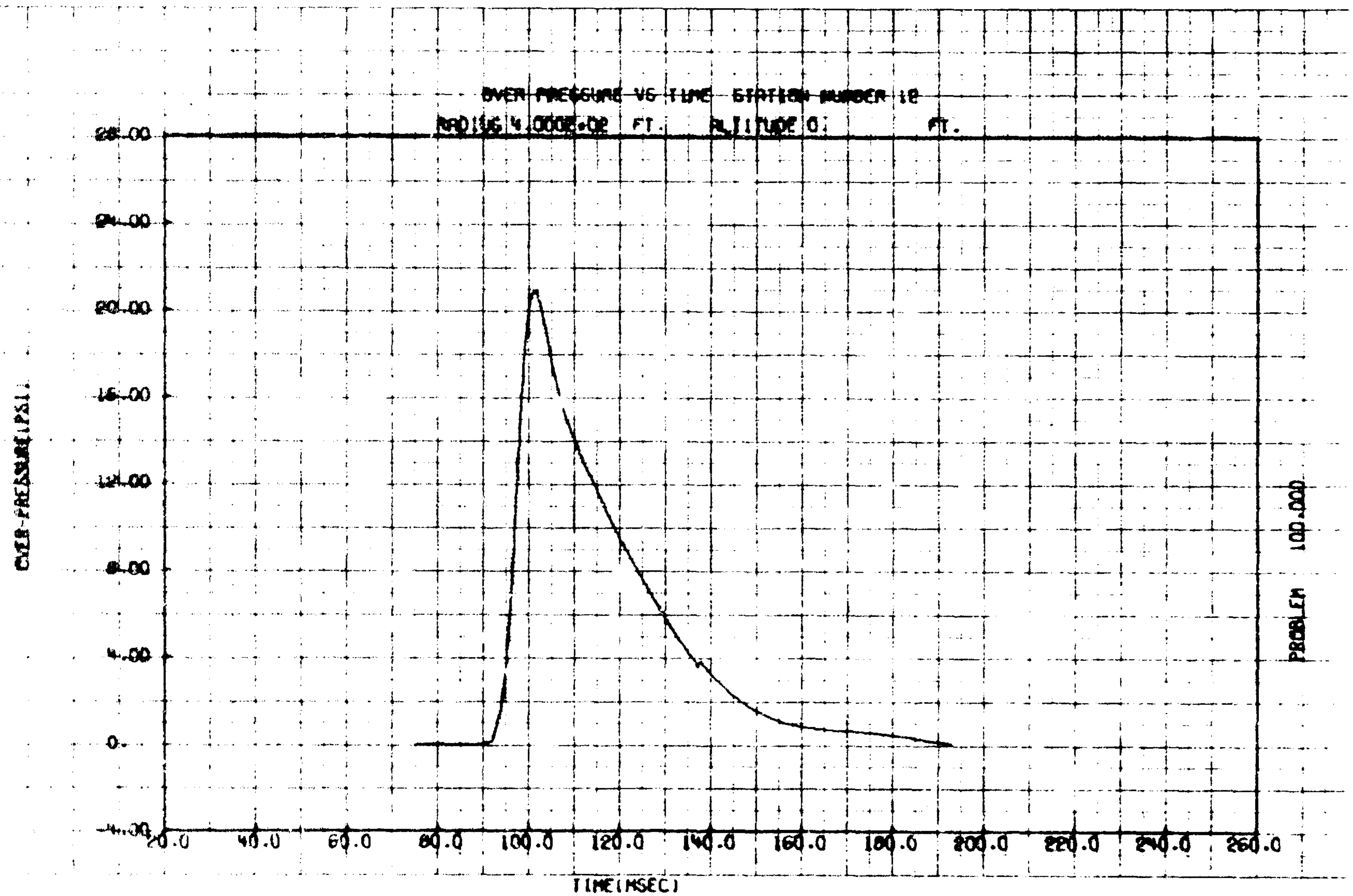

OVER-PRESSURE VS TIME STATION NUMBER 11
RADIUS 3.1400E+02 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
OVER-PRESSURE(PSI)
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
60.00
50.00
40.00
30.00
20.00
10.00
0.
-10.00
-20.00


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 11
RADIUS FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
OVER PRESSURE IMPULSE(LB-MSEC.)
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
-100.00
0.
100.00
200.00
400.00
500.00
600.00
700.00

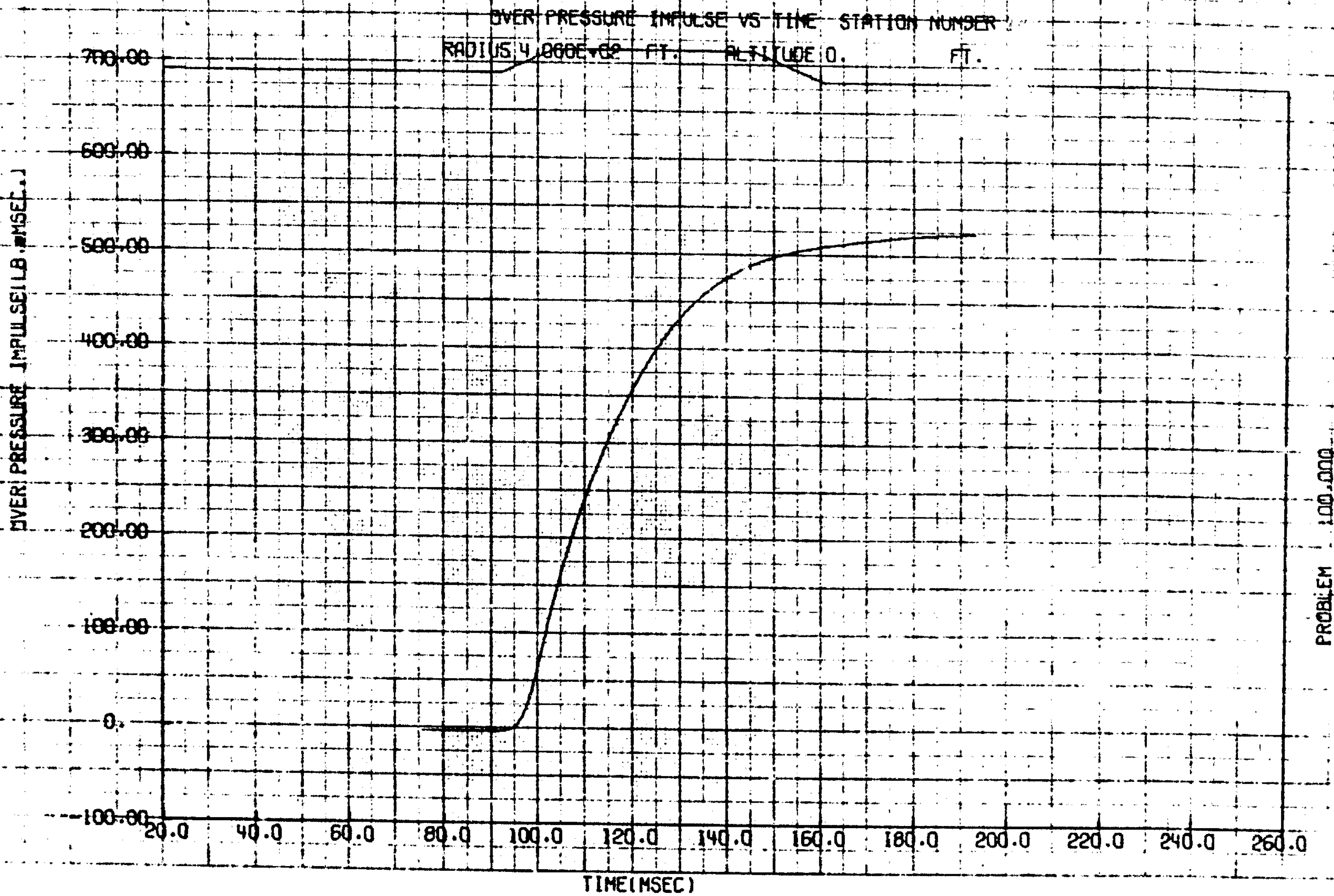

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 11
RADIUS 3.400E+02 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
3200.00
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
TIME(MSEC)
PROBLEM 100.000

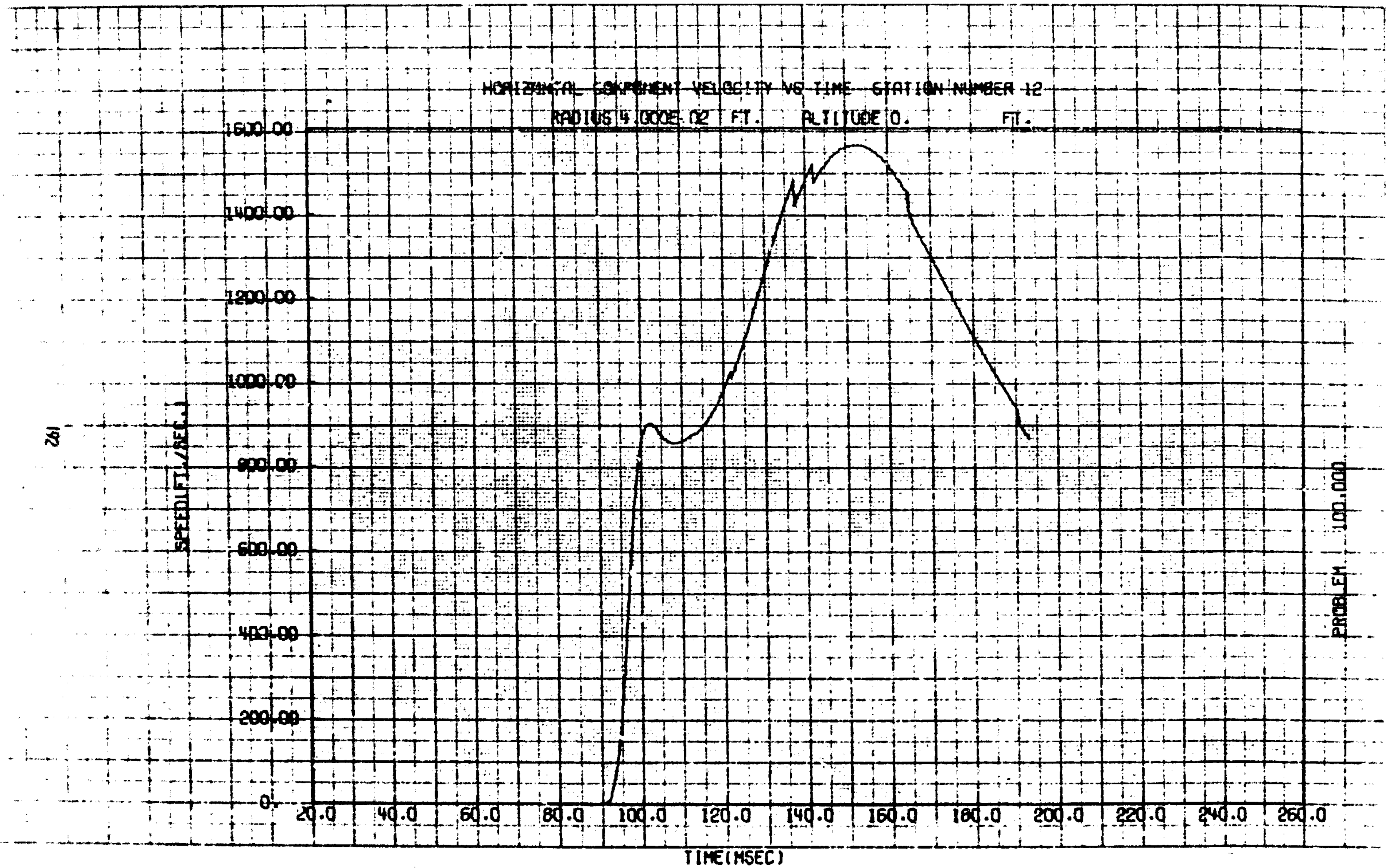

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER
ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.
-10.00
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0

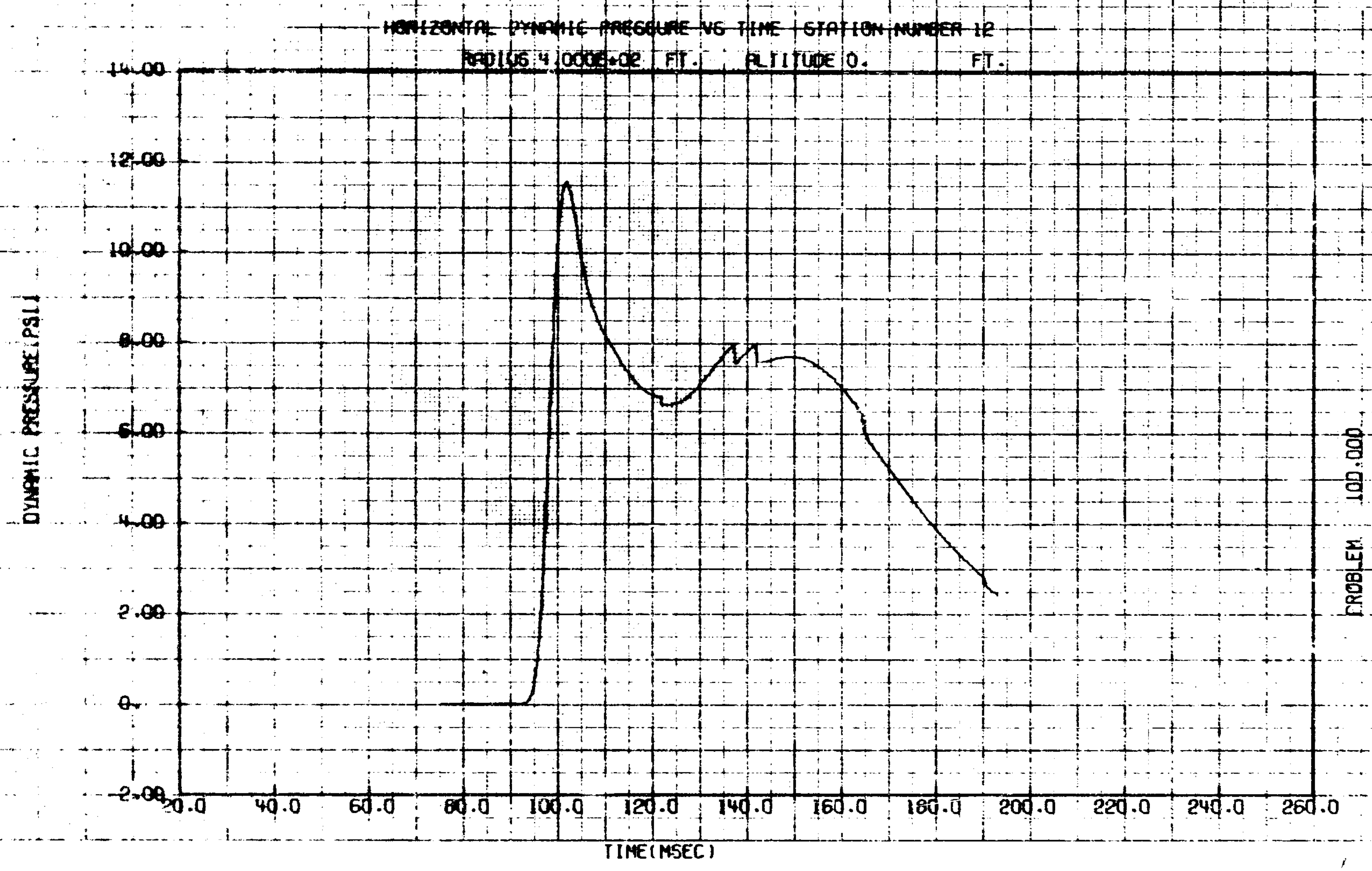

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 11
RADIUS 3.400E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
TIME(MSEC)
PROBLEM 100.000

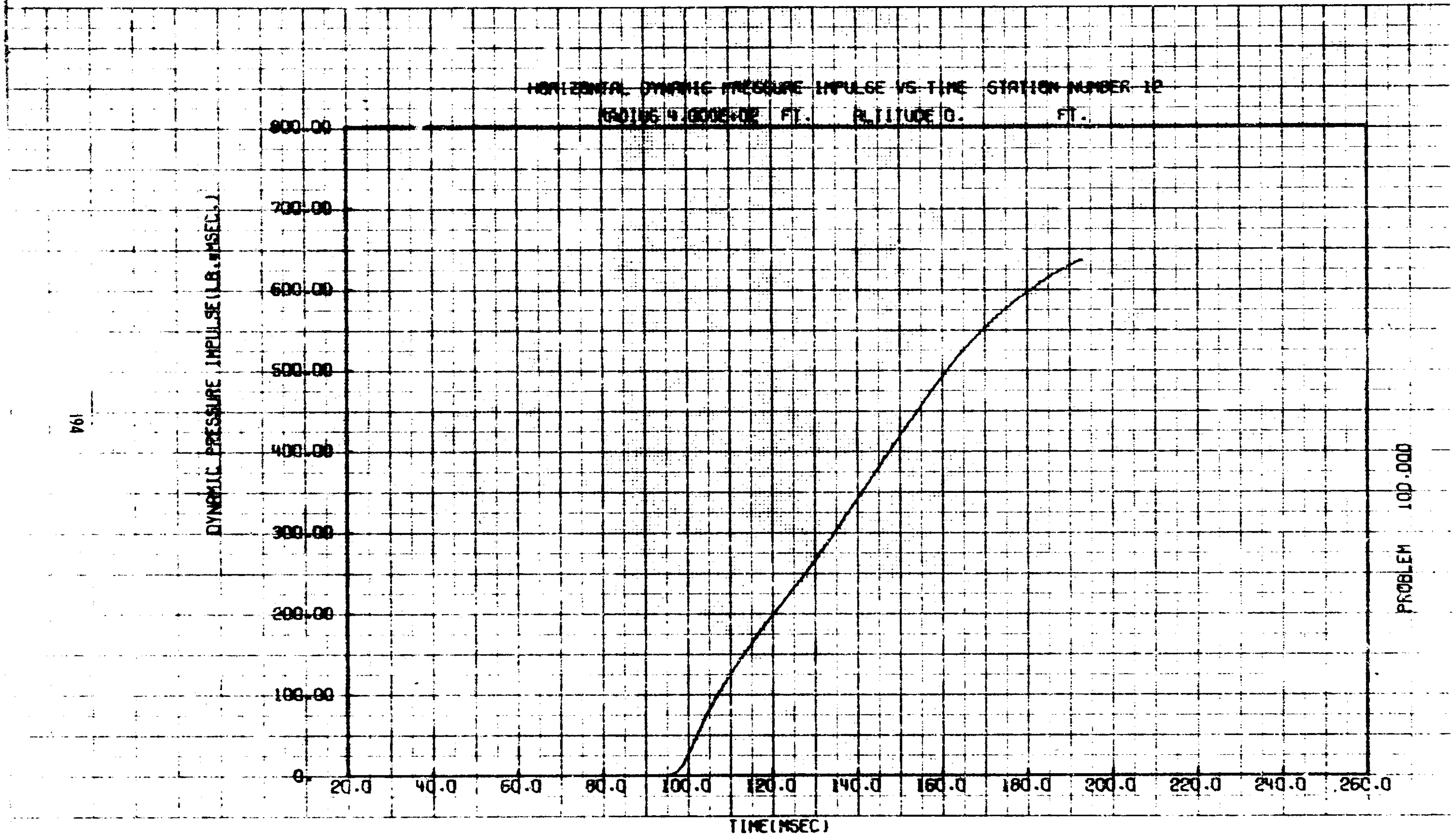


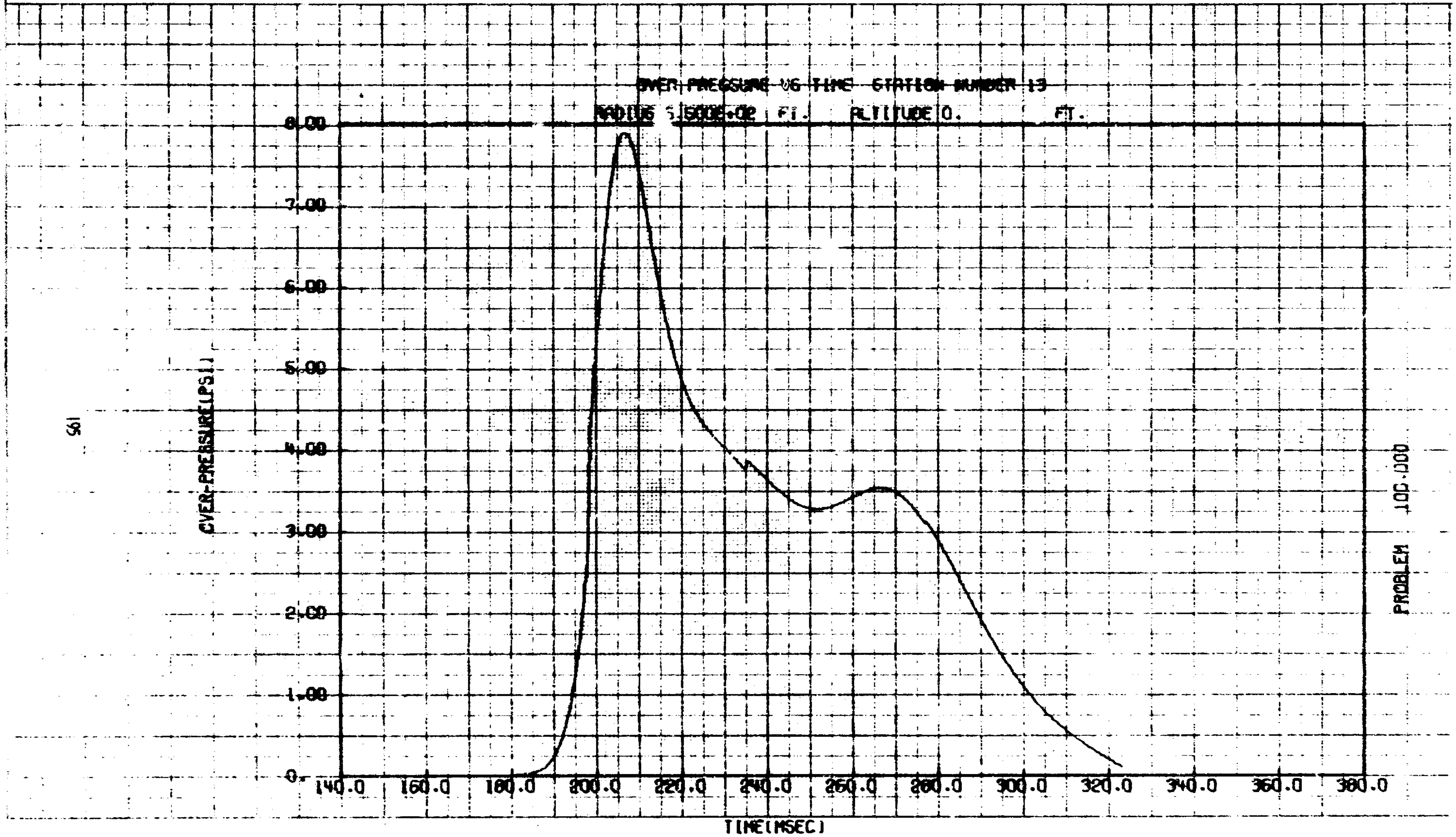
OVER PRESSURE VS TIME STATION NUMBER 18
RADIUS 4.000E+02 FT. ALTITUDE 0. FT.
28.00
24.00
20.00
16.00
12.00
8.00
4.00
0.
-4.00
OVER-PRESSURE(PSI)
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
TIME(MSEC)
PROBLEM 100.000

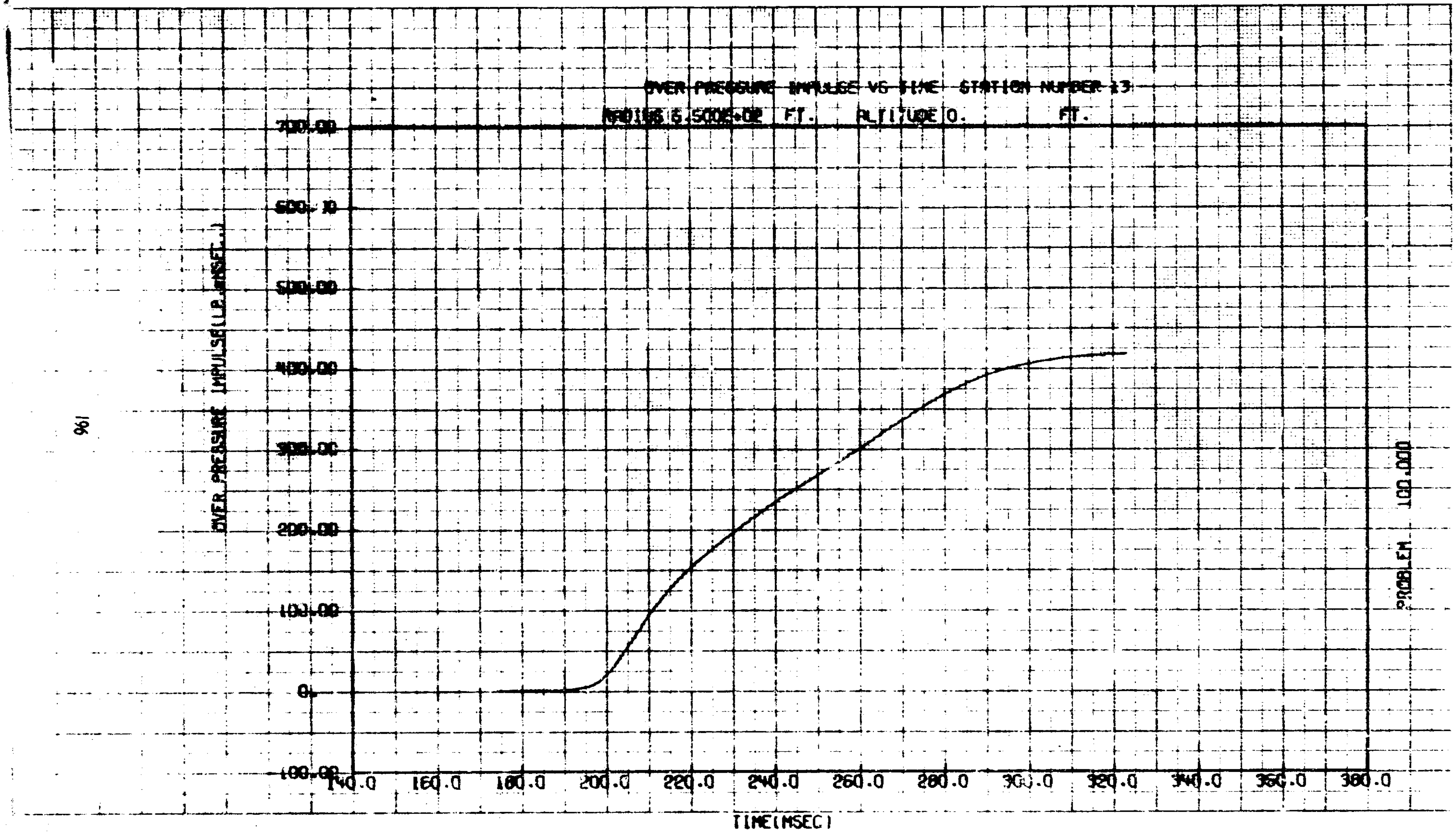

OVER PRESSURE IMPULSE VS TIME STATION NUMBER
RADIUS 4.000E+02 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.*MSEC.)
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.
-100.00
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
TIME(MSEC)
PROBLEM 100.000

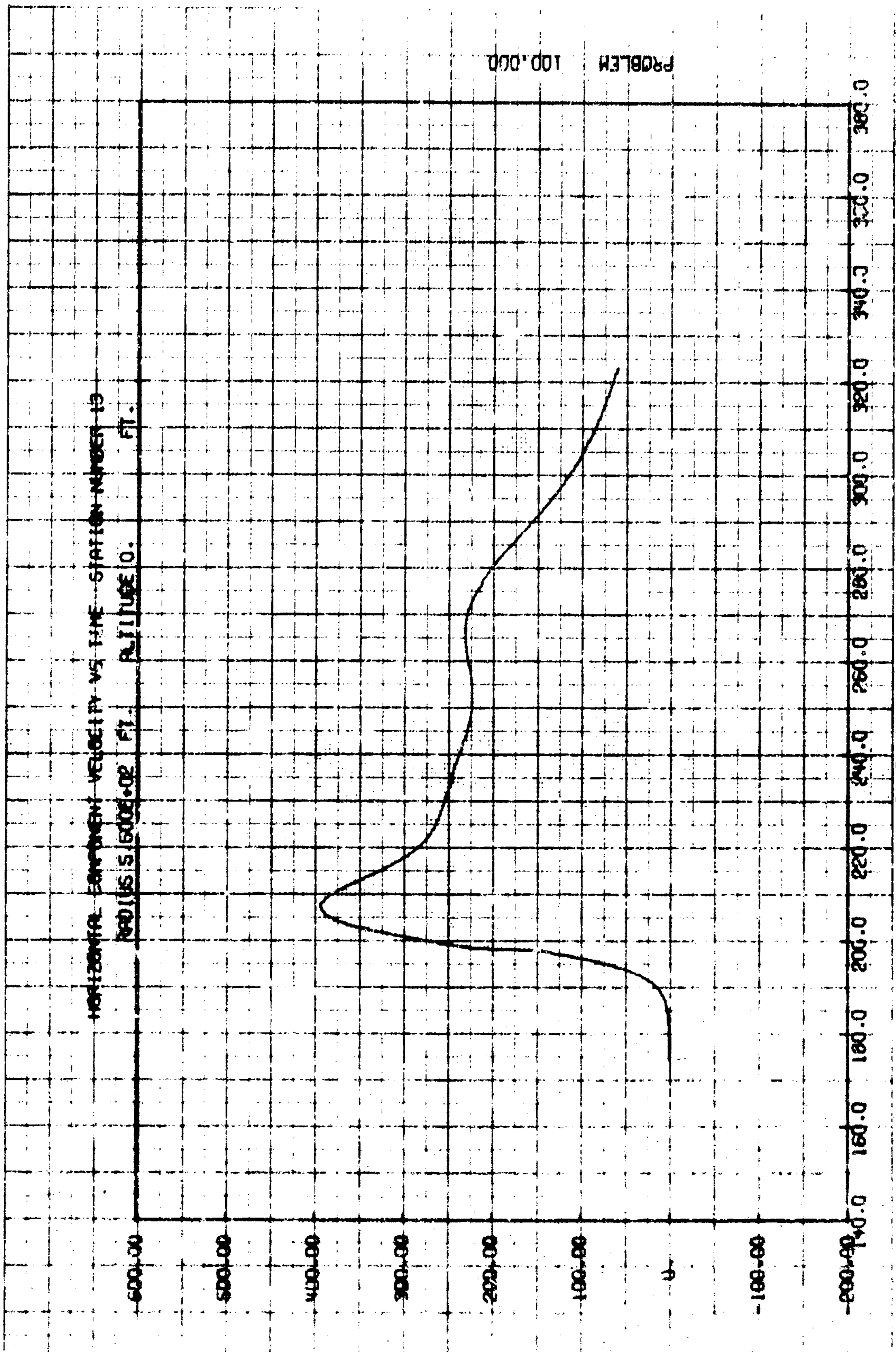

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 12
RADIUS 4.000E 02 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
TIME(MSEC)
PROBLEM 100.000

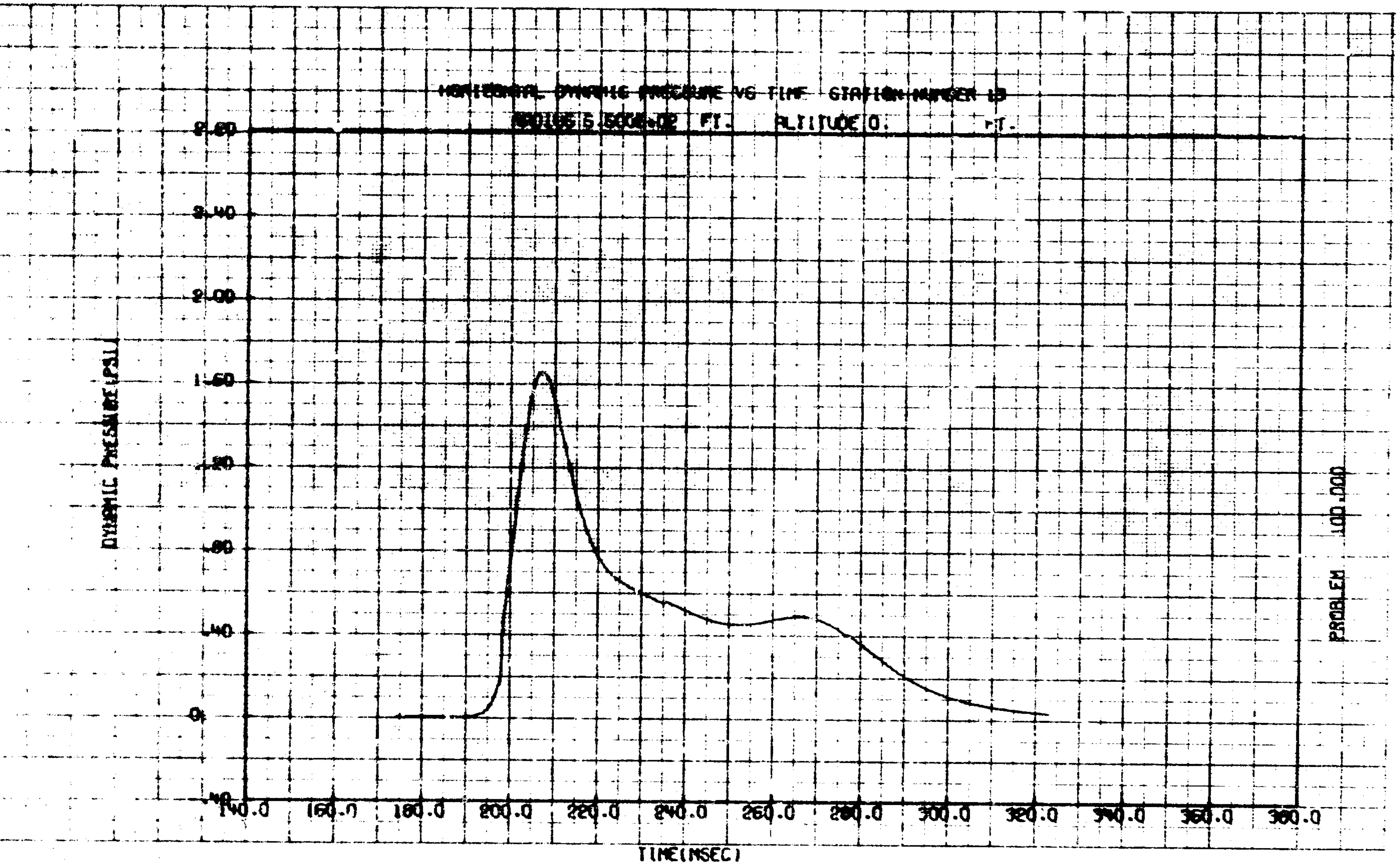

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 12
RADIUS 4.000E+02 FT. ALTITUDE 0. FT.
PROBLEM 100.000
DYNAMIC PRESSURE (PSI)
TIME (MSEC)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.
-2.00
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0

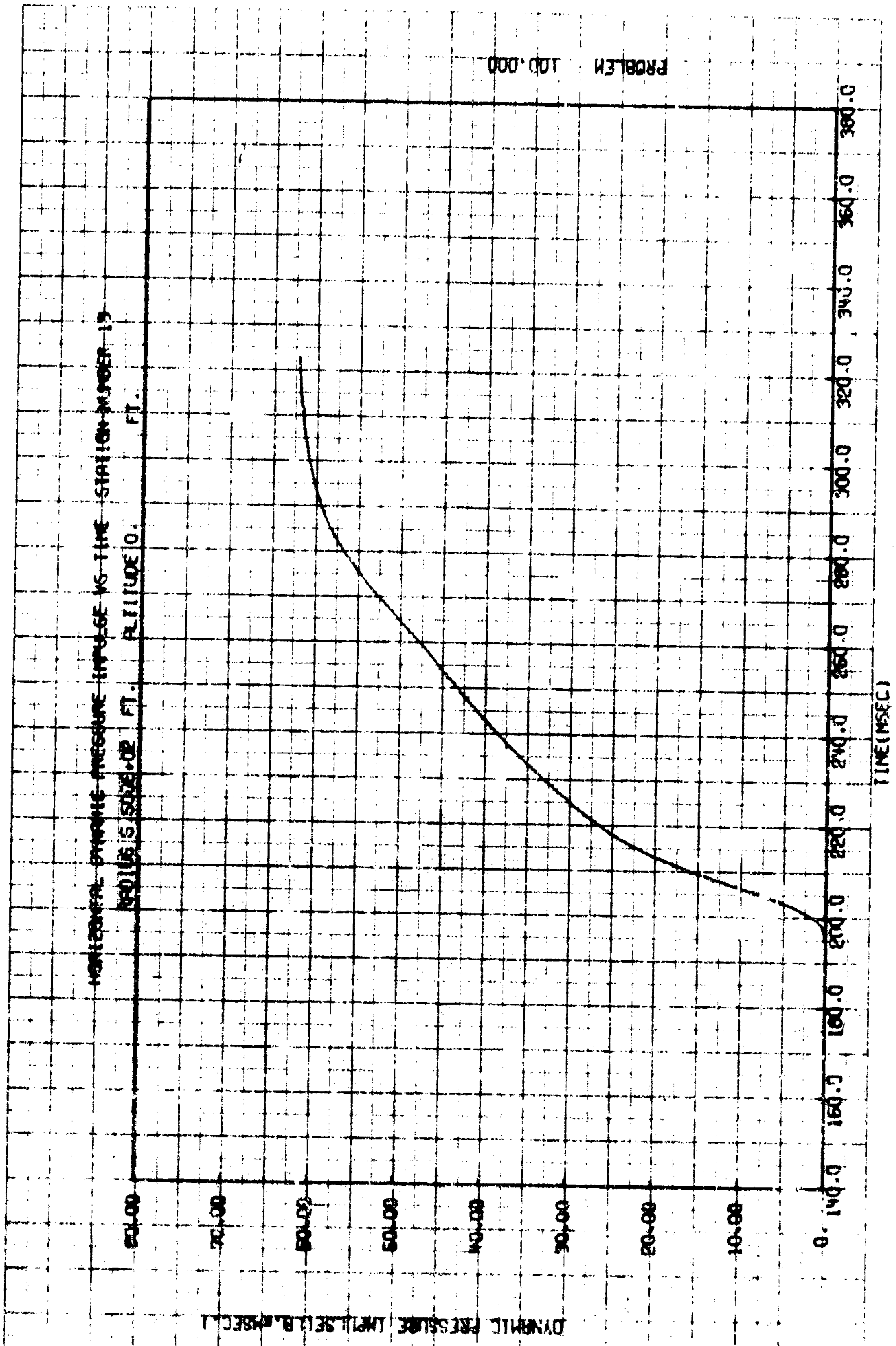

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 12
RADIUS 4.000E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
900.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
TIME(MSEC)
PROBLEM 100.000

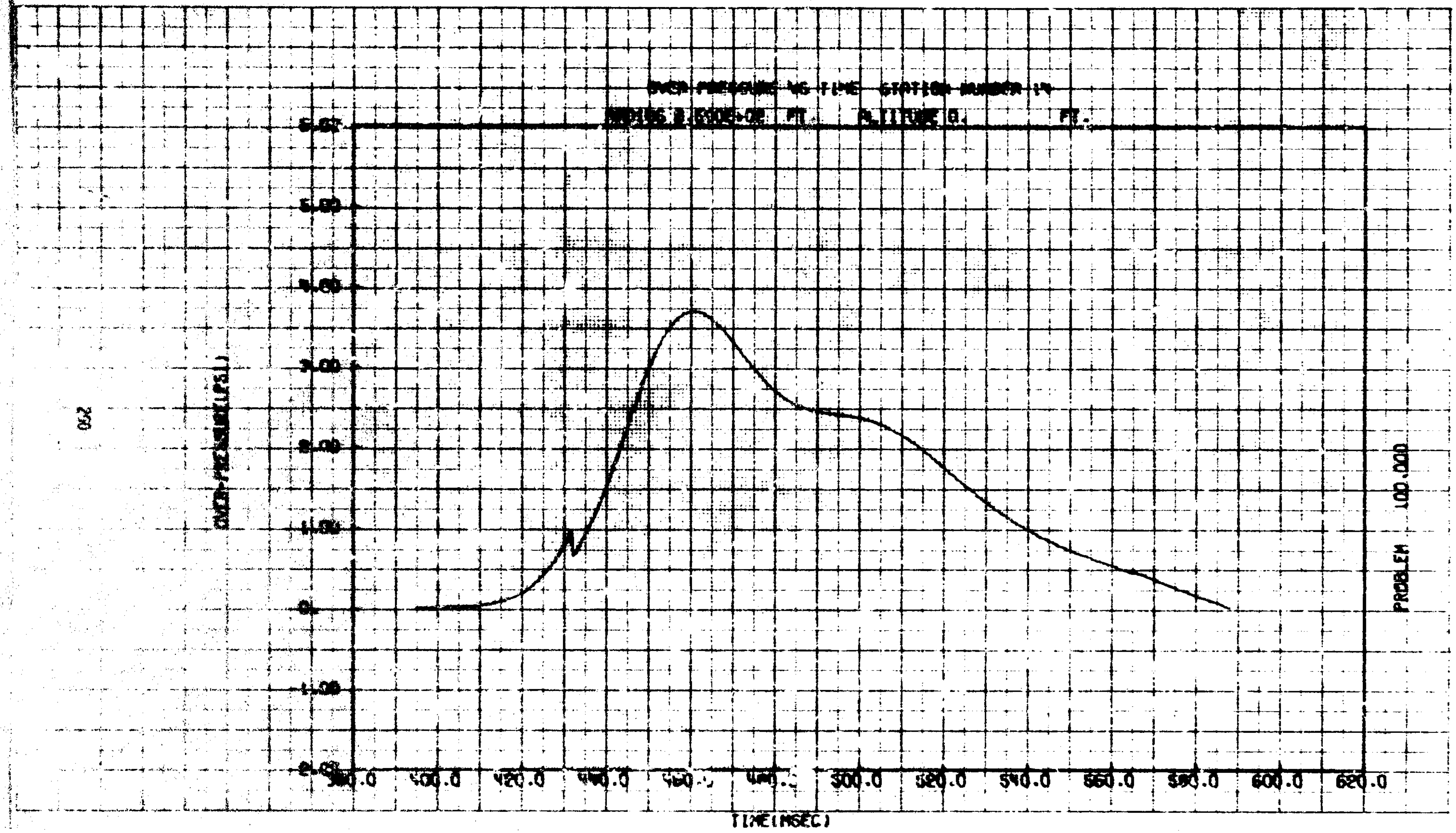

OVER PRESSURE VS TIME STATION NUMBER 13
RADIUS 5.500E+02 FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
TIME(MSEC)
PROBLEM 100.000

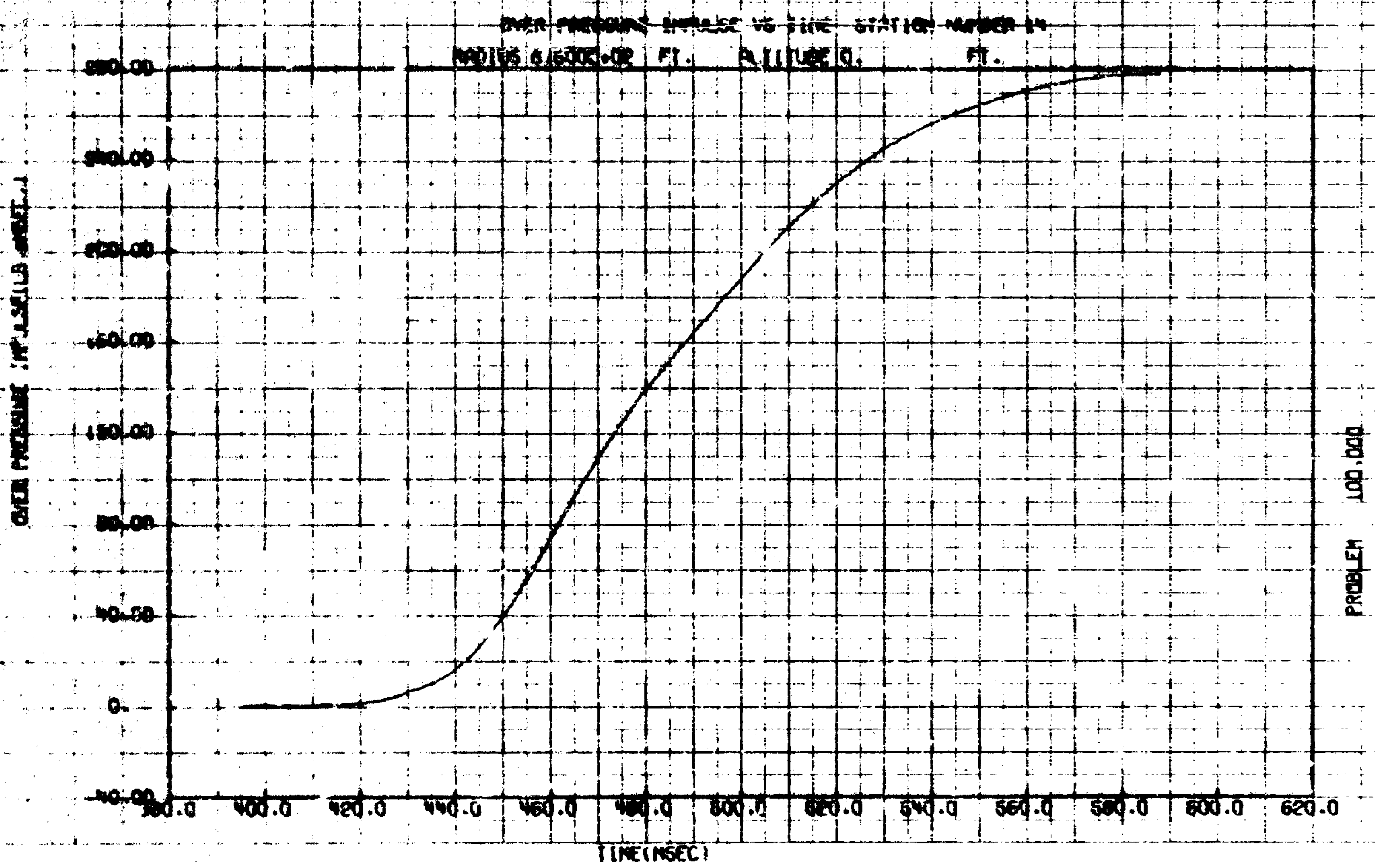

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 13
RADIUS 5.500E+02 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.MSEC.)
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.
-100.00
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
TIME(MSEC)
PROBLEM 100.000

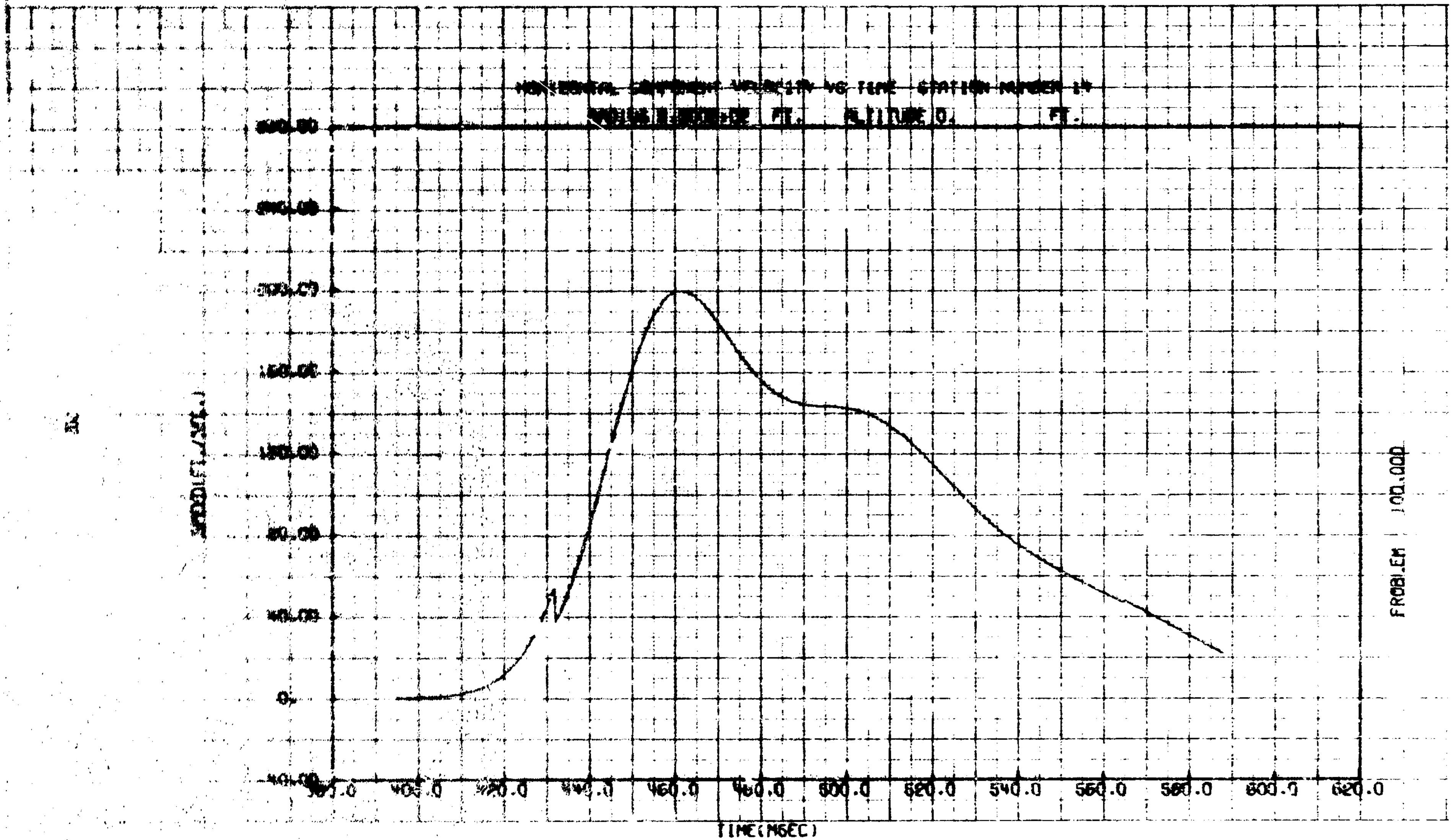

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 13
RADIUS 1.500E+02 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME (MSEC)
SPEED (FT./SEC.)
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
-200.00
-100.00
0
100.00
200.00
300.00
400.00
500.00
600.00

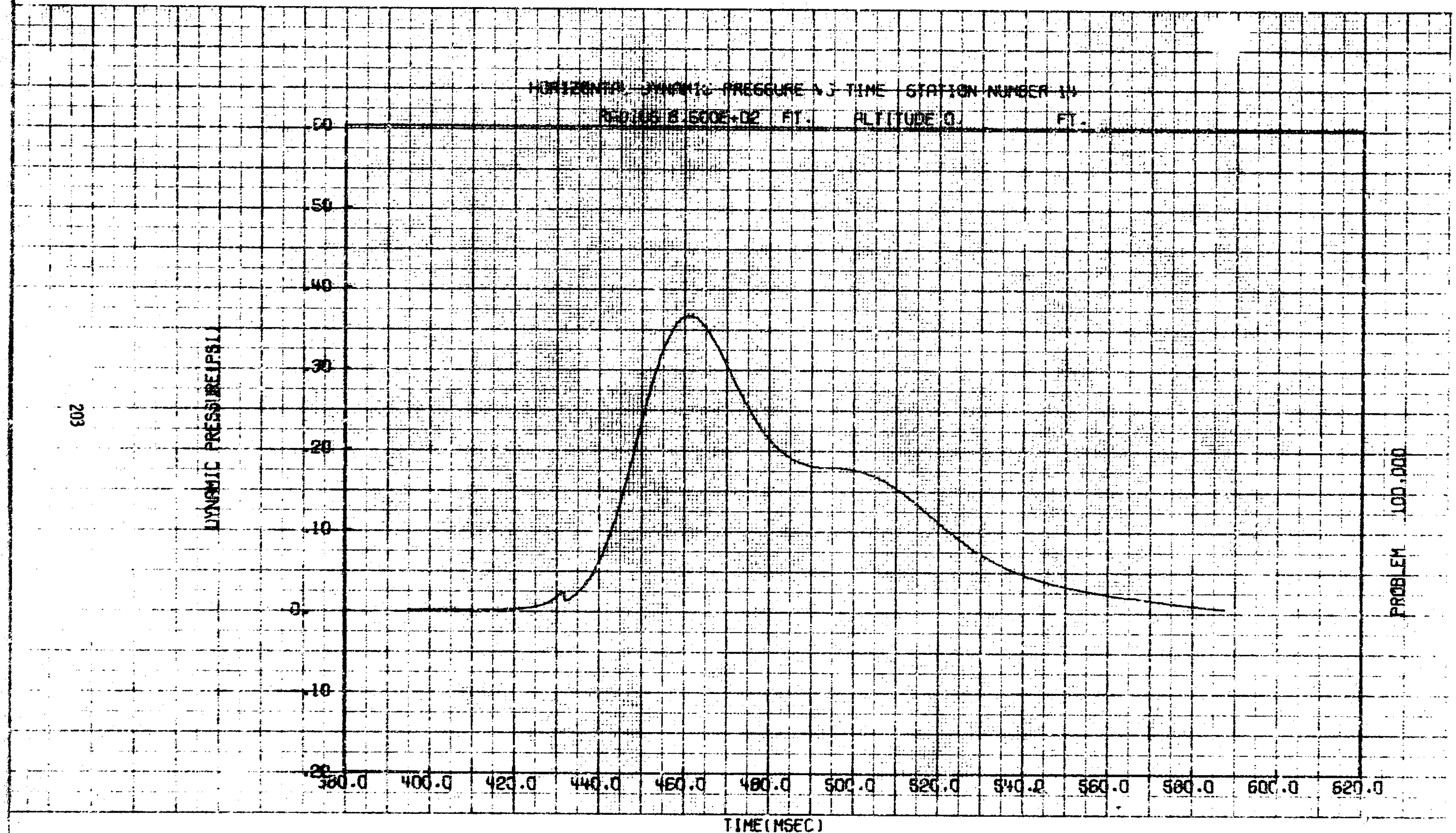

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 13
RADIUS 5.500E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
2.80
2.40
2.00
1.60
1.20
.80
.40
0
-.40
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
TIME(MSEC)
PROBLEM 100.000

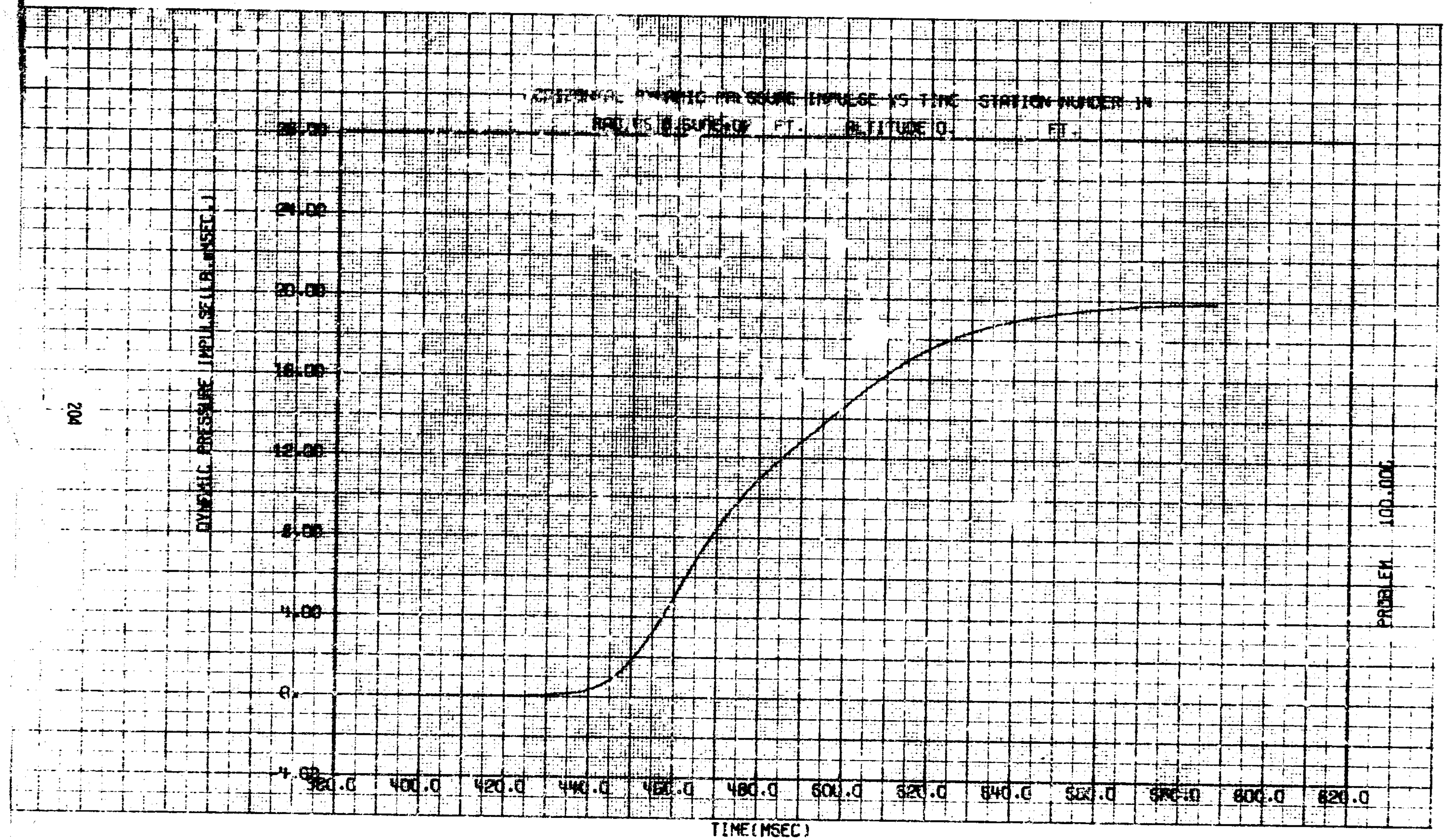

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 15
RADIUS 5.500E+02 FT. ALTITUDE 0. FT.
PROBLEM 100.000
TIME(MSEC)
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
0.
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00

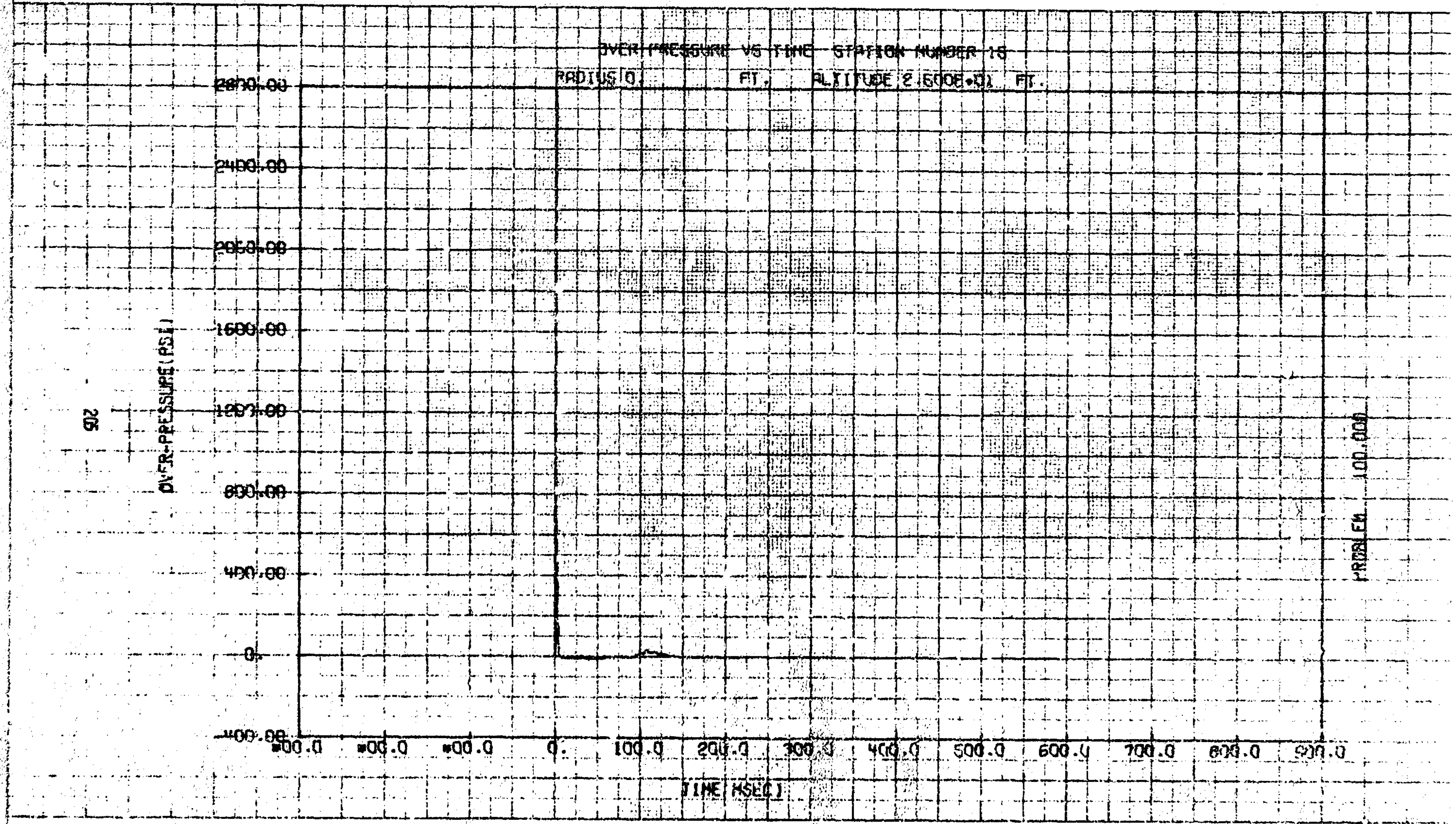

OVER-PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
5.00
4.00
3.00
2.00
1.00
0
-1.00
400.0
420.0
440.0
500.0
520.0
540.0
560.0
580.0
600.0
620.0

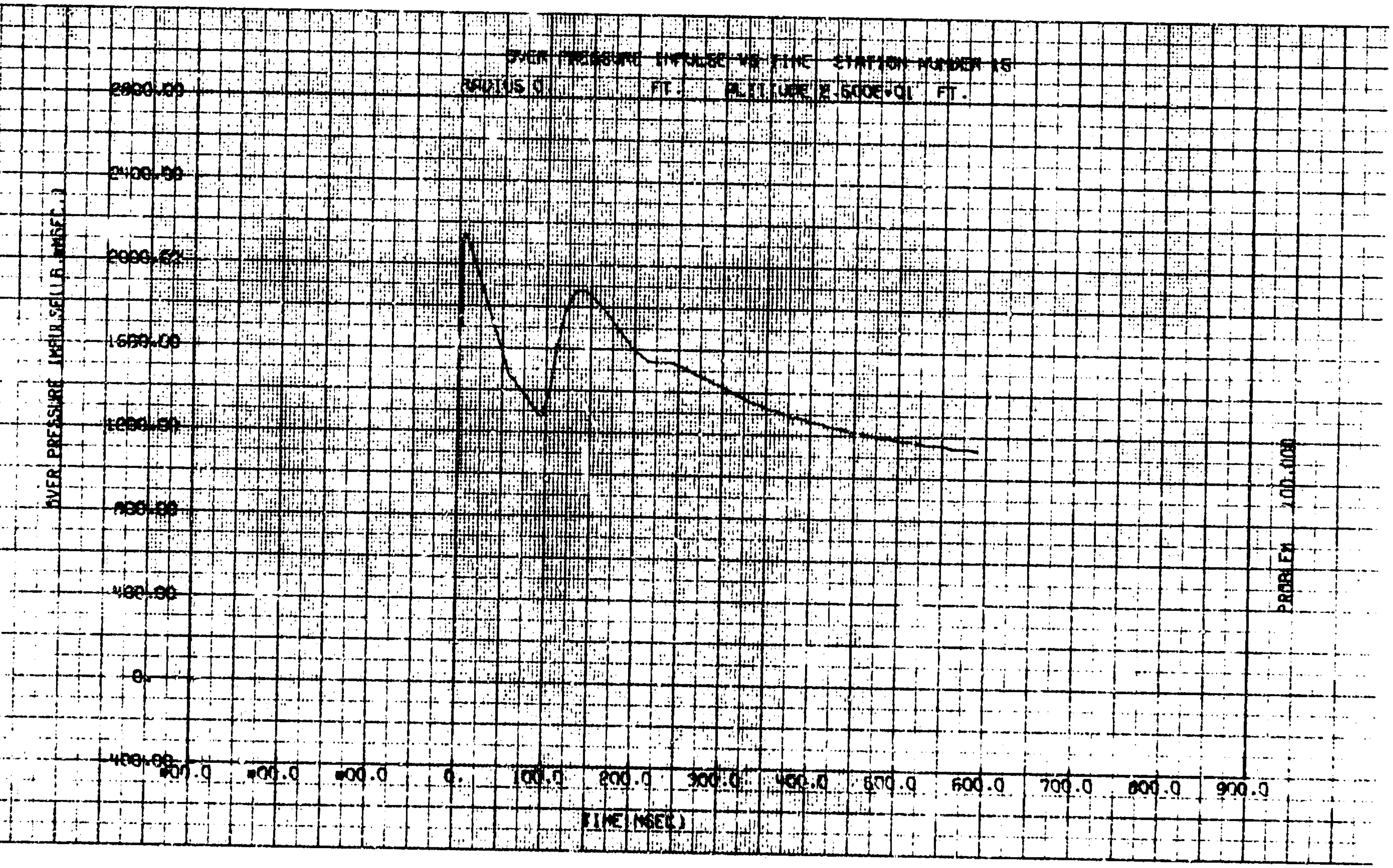

TIME(MSEC)
PROBLEM 100.000
400.0
420.0
440.0
460.0
620.0
0.
40.00

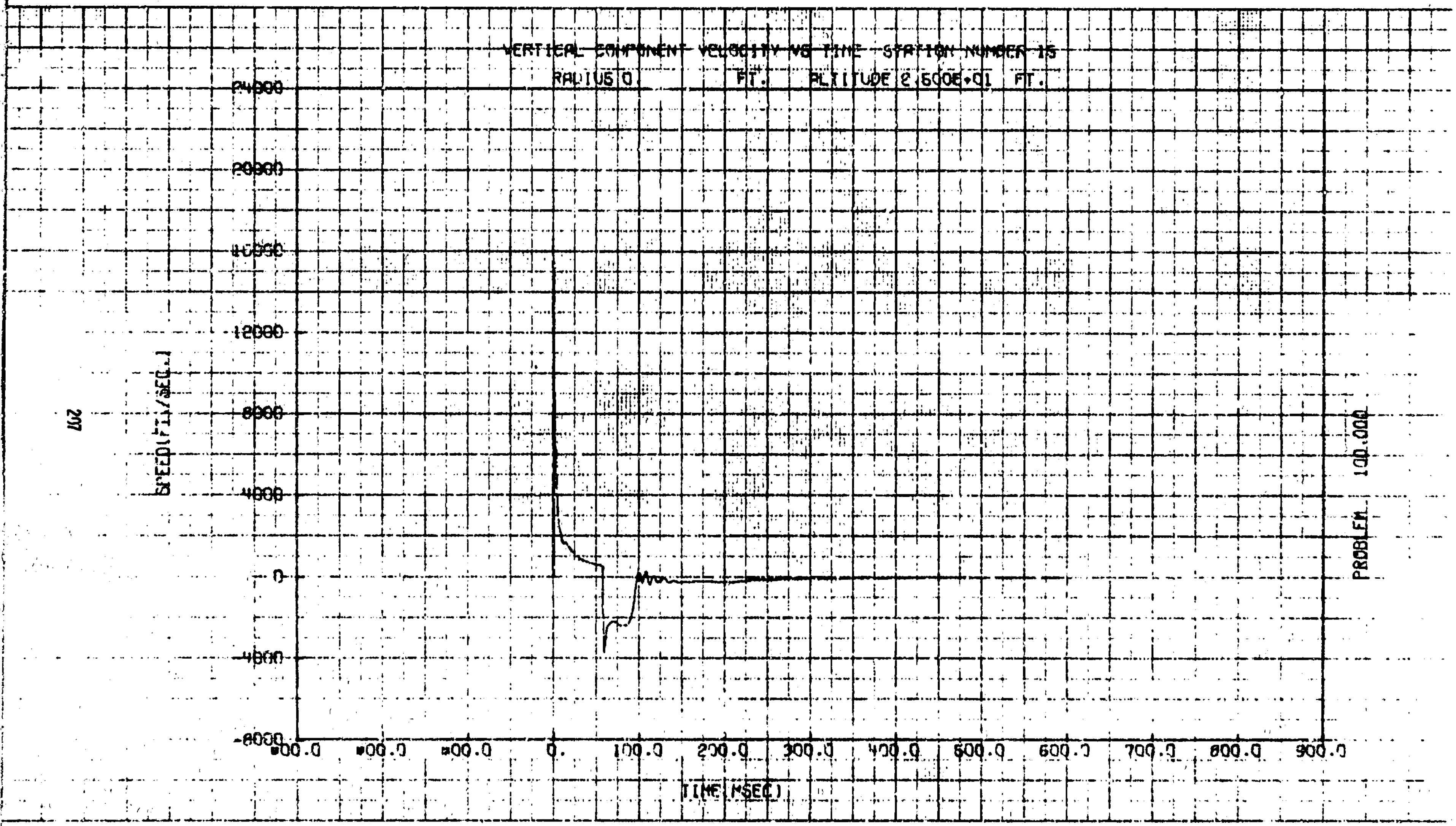

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 14
FT. ALTITUDE 0. FT.
0.
40.00
80.00
120.00
160.00
200.00
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0
580.0
600.0
620.0
TIME(MSEC)
PROBLEM 100.000

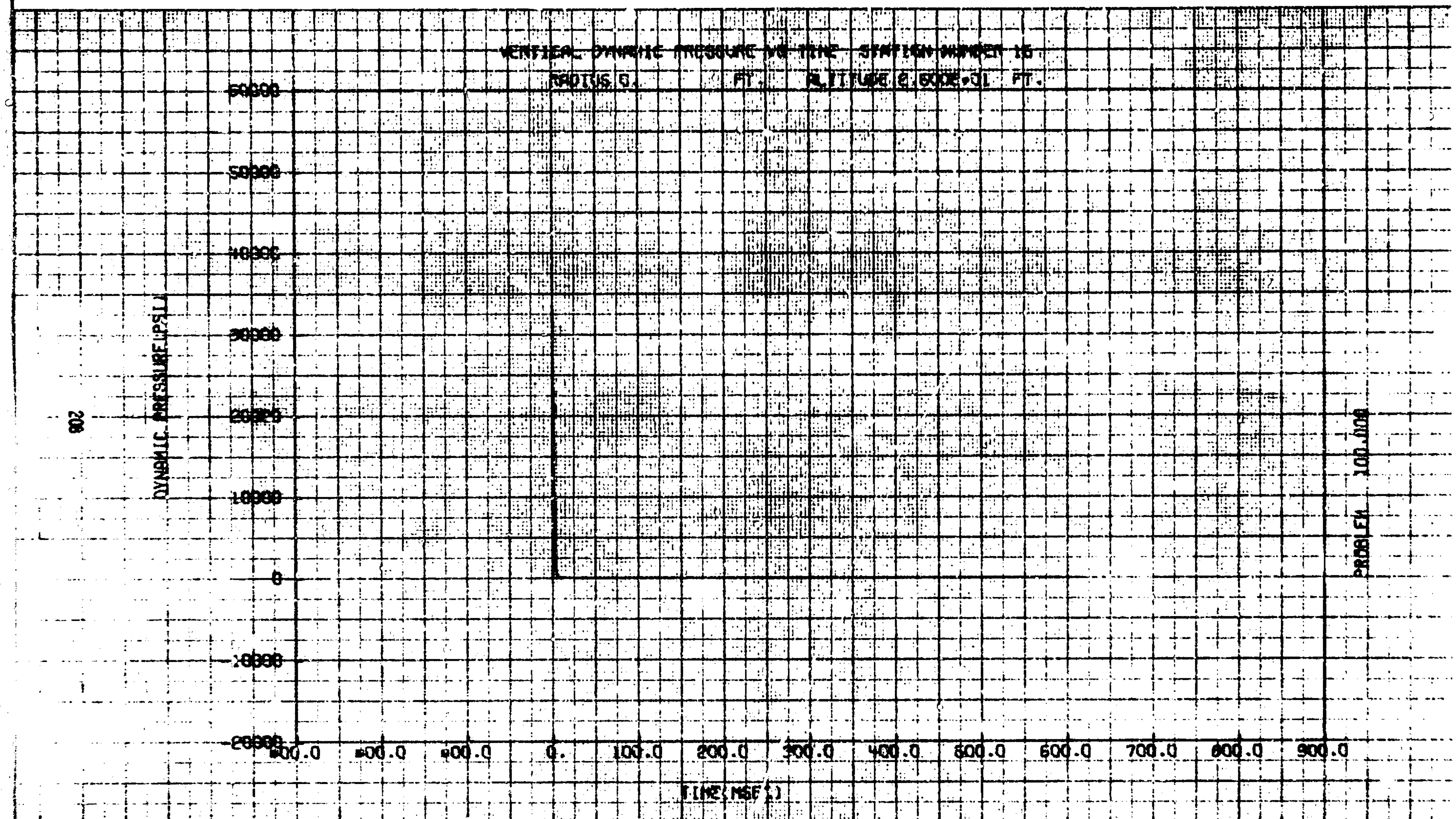

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 14
RADIUS 8.500E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
60
50
40
30
20
10
0
-10
-20
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0
580.0
600.0
620.0
TIME(MSEC)
PROBLEM 100.000


IMPULSE VS TIME
ALTITUDE 0.
FT.
DYNAMIC PRESSURE IMPULSE(LB.-MSEC.)
24.00
20.00
16.00
12.00
8.00
4.00
0.
400.0
420.0
440.0
480.0
520.0
540.0
600.0
620.0
TIME(MSEC)
PROBLEM 100.00C

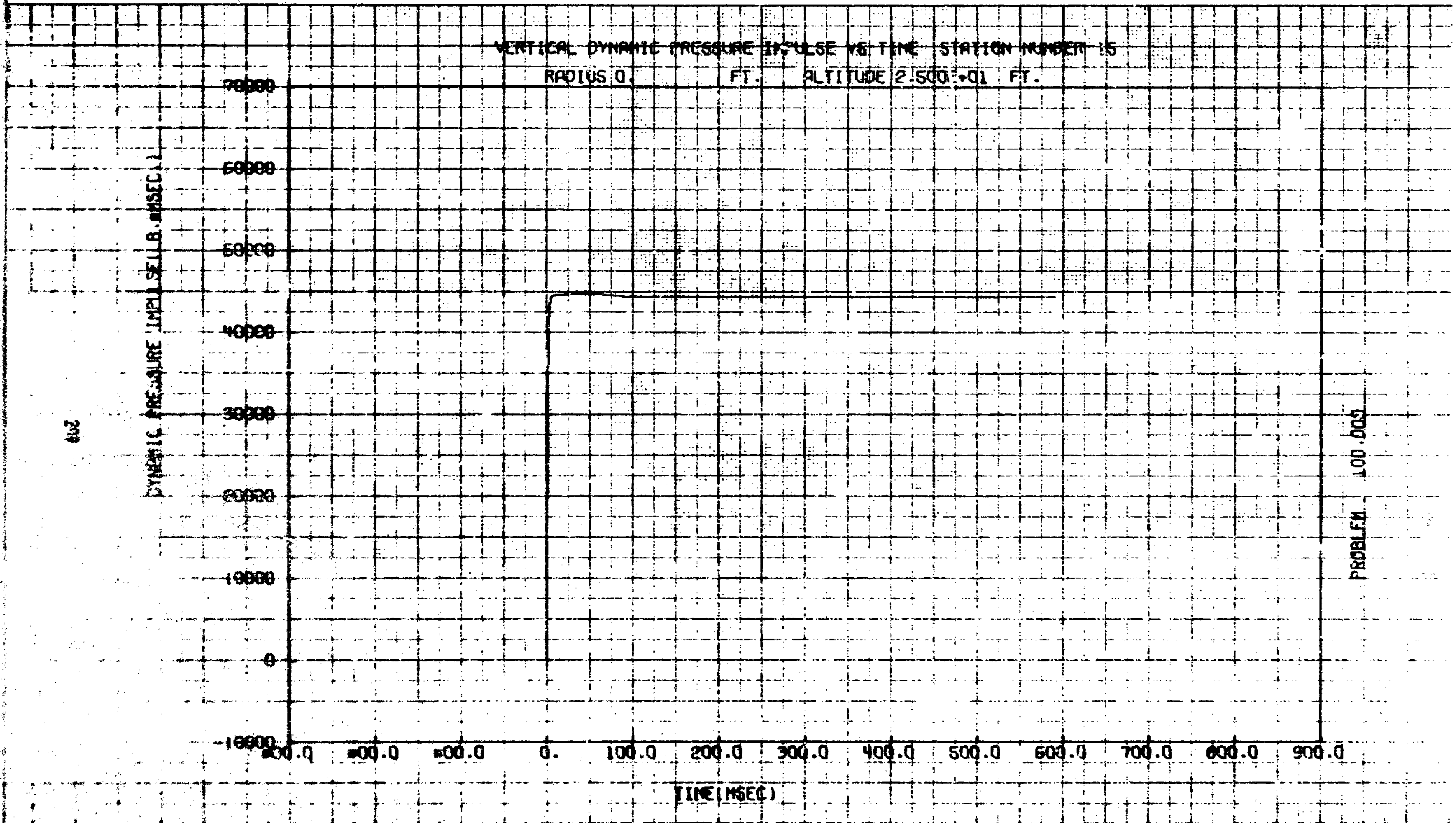

OVERPRESSURE VS TIME STATION NUMBER 15
RADIUS 0. FT. ALTITUDE 2.600E+01 FT.
OVER-PRESSURE(PSI)
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

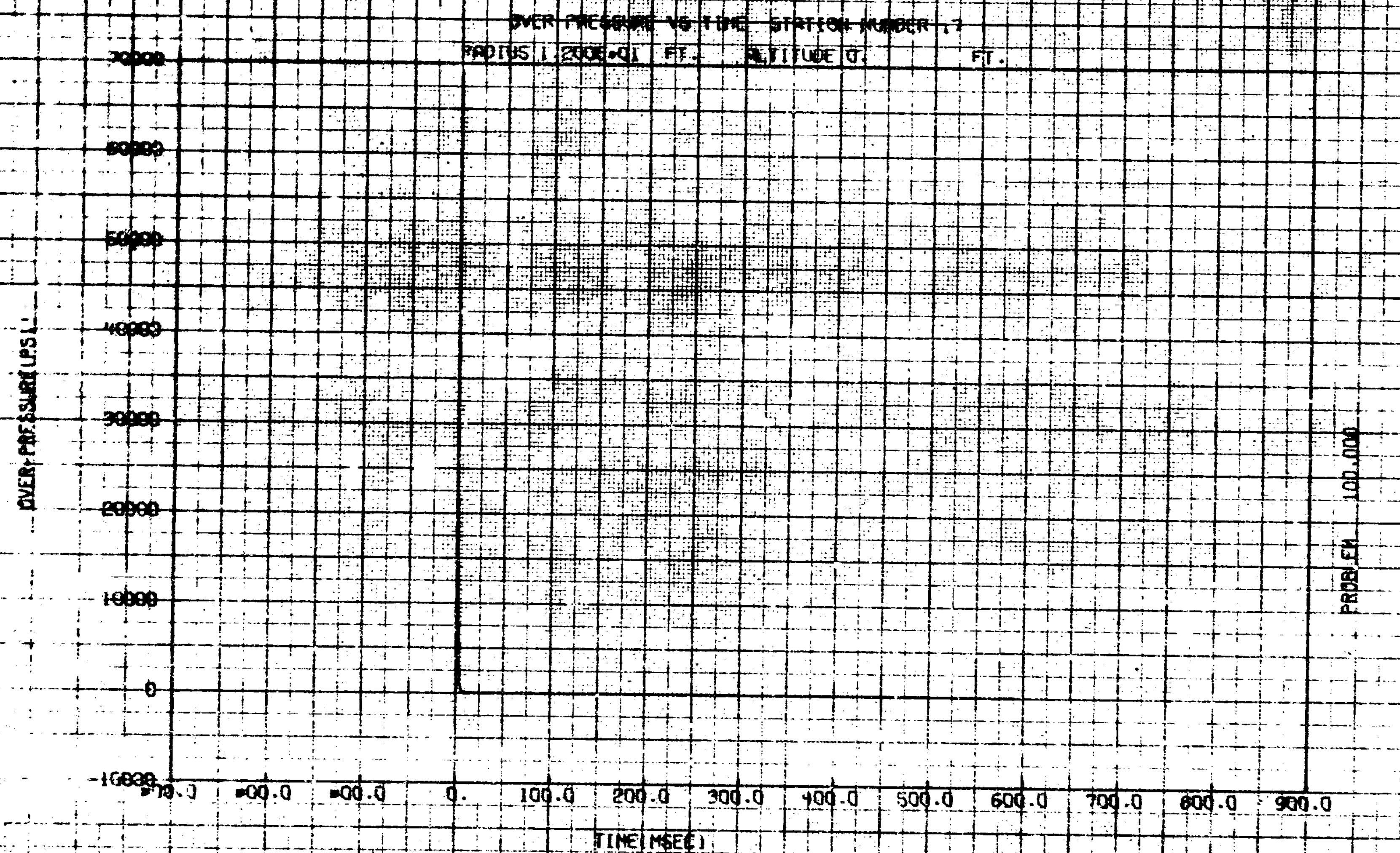

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 15
RADIUS 0. FT. ALTITUDE 2.500E+01 FT.
2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME MSEC.)
OVER PRESSURE IMPULSE(LB.MSEC.)
PROBLEM 700.000

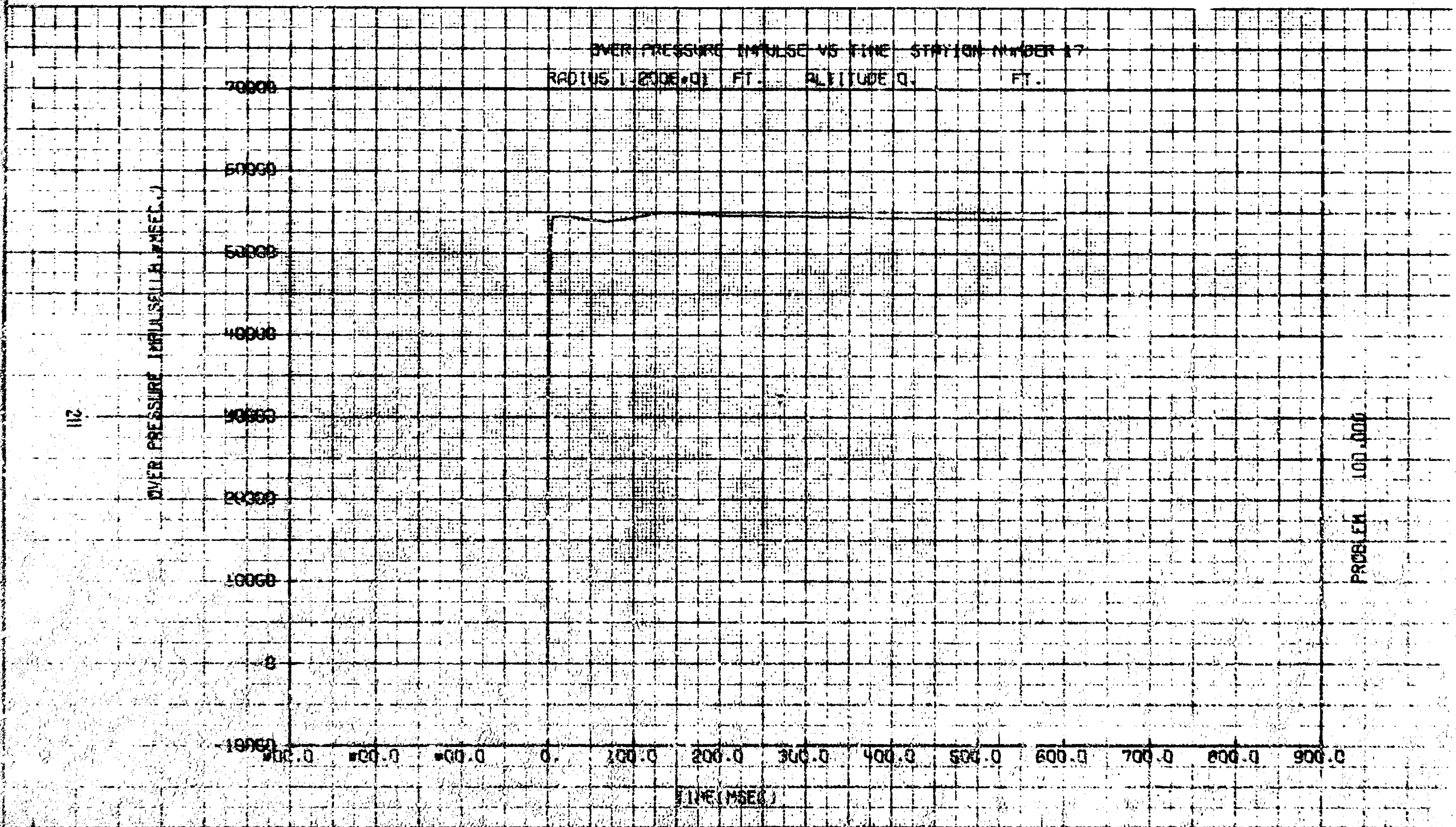

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 15
RADIUS 0 FT. ALTITUDE 2.500E+01 FT.
24000
20000
16000
12000
8000
4000
0
-4000
-8000
SPEED(FT/SEC.)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

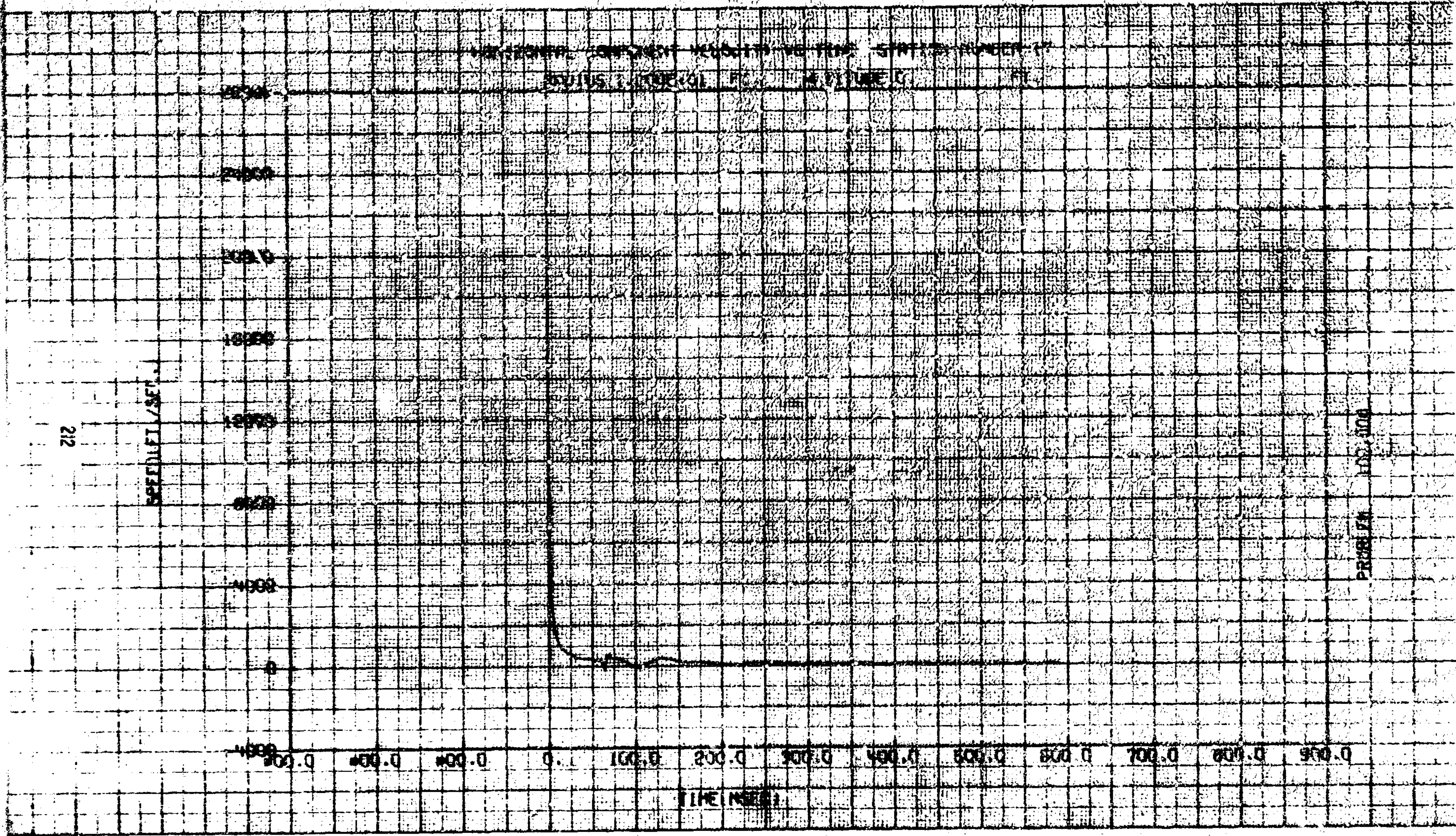


VERTICAL DYNAMIC PRESSURE VS TIME   STATION NUMBER 15
RADIUS 0.   FT.   ALTITUDE 2.500E+01   FT.
DYNAMIC PRESSURE(PSI)
60000
50000
40000
30000
20000
10000
0
-10000
-20000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM   100.008

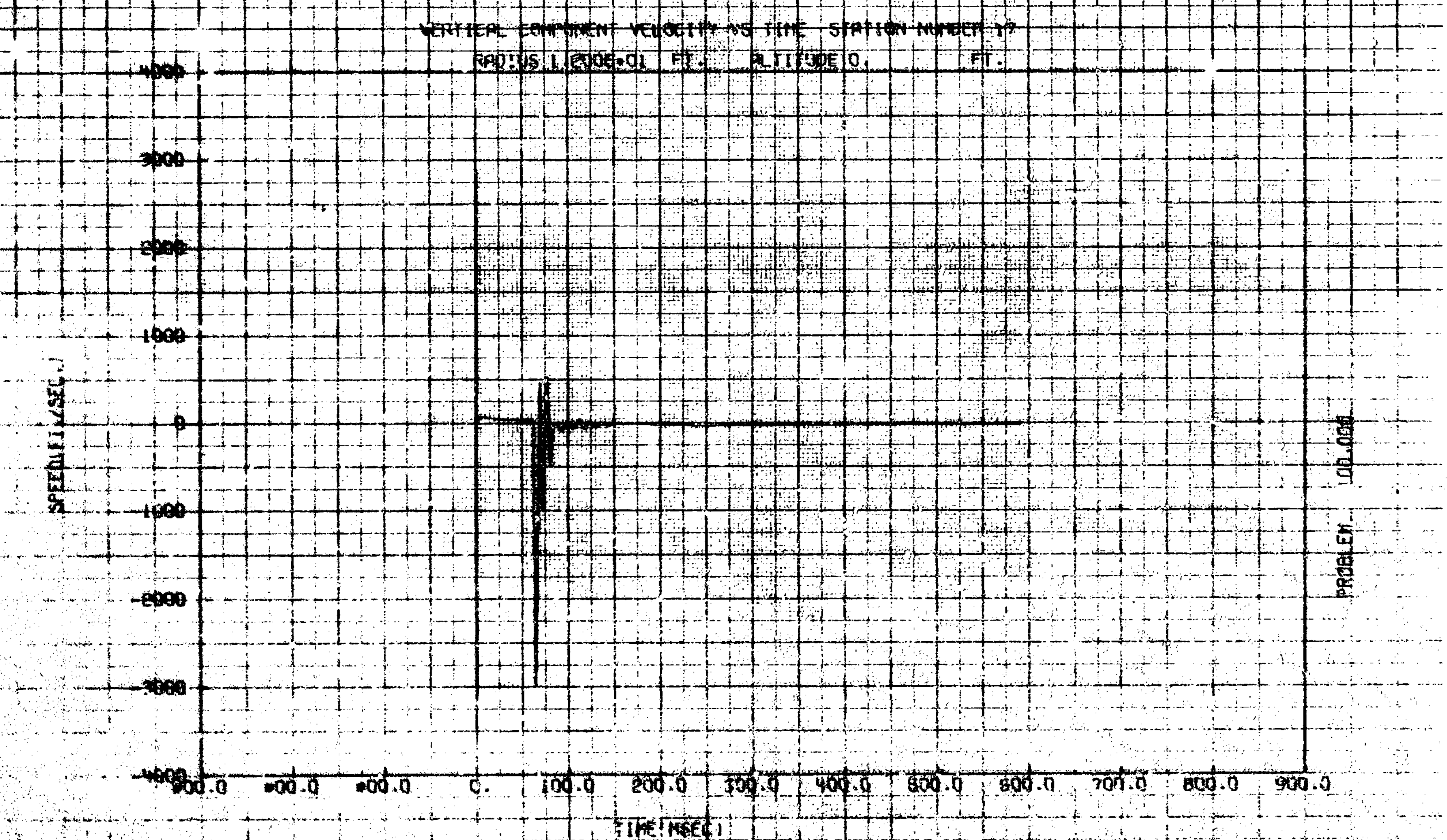

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 15
RADIUS 0. FT. ALTITUDE 2.500+01 FT.
70000
60000
50000
40000
30000
20000
10000
0
-10000
DYNAMIC PRESSURE IMPULSE(LB.MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.005

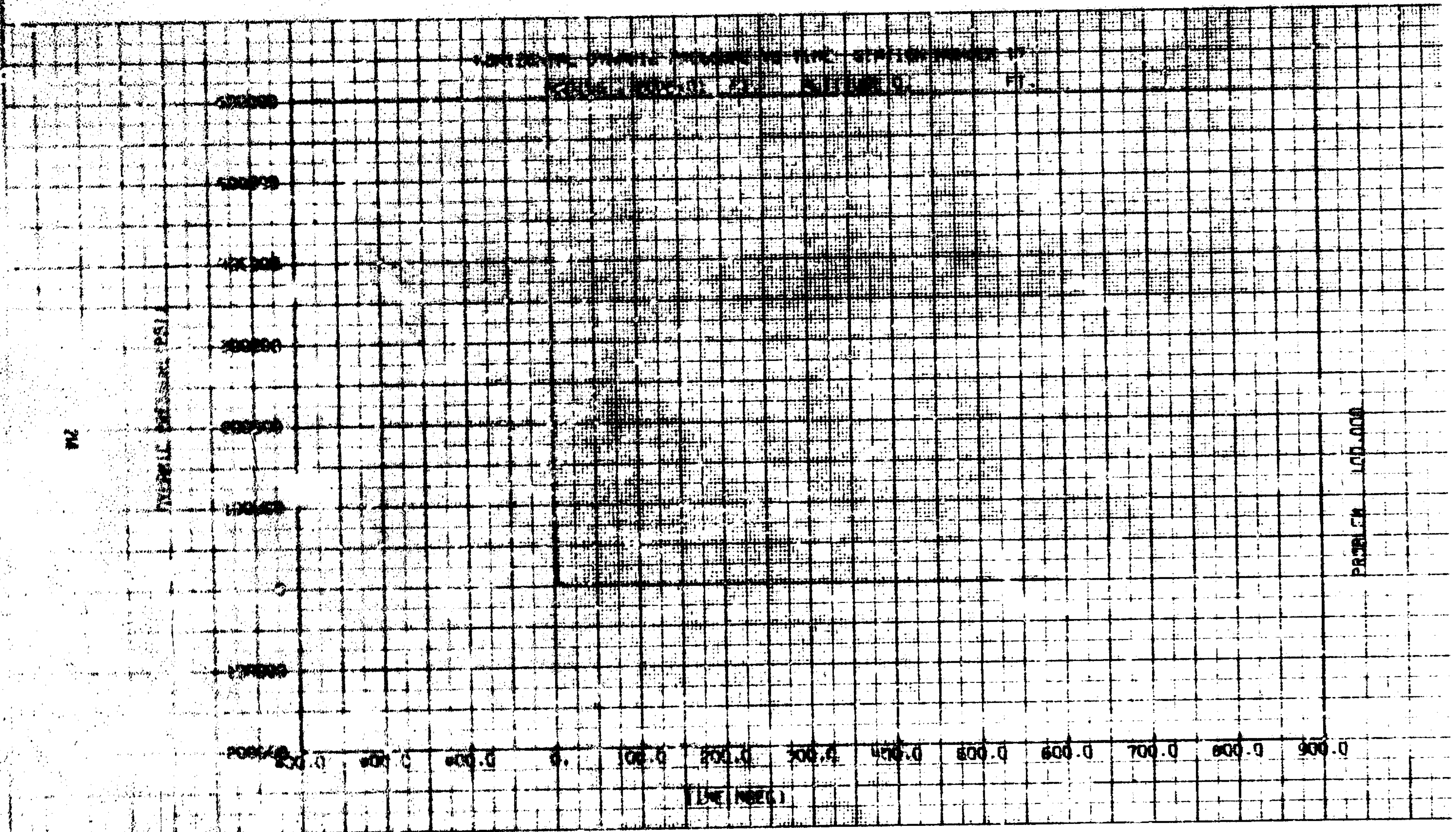

OVER PRESSURE VS TIME STATION NUMBER
RADIUS FT. ALTITUDE 0. FT.
OVER-PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0

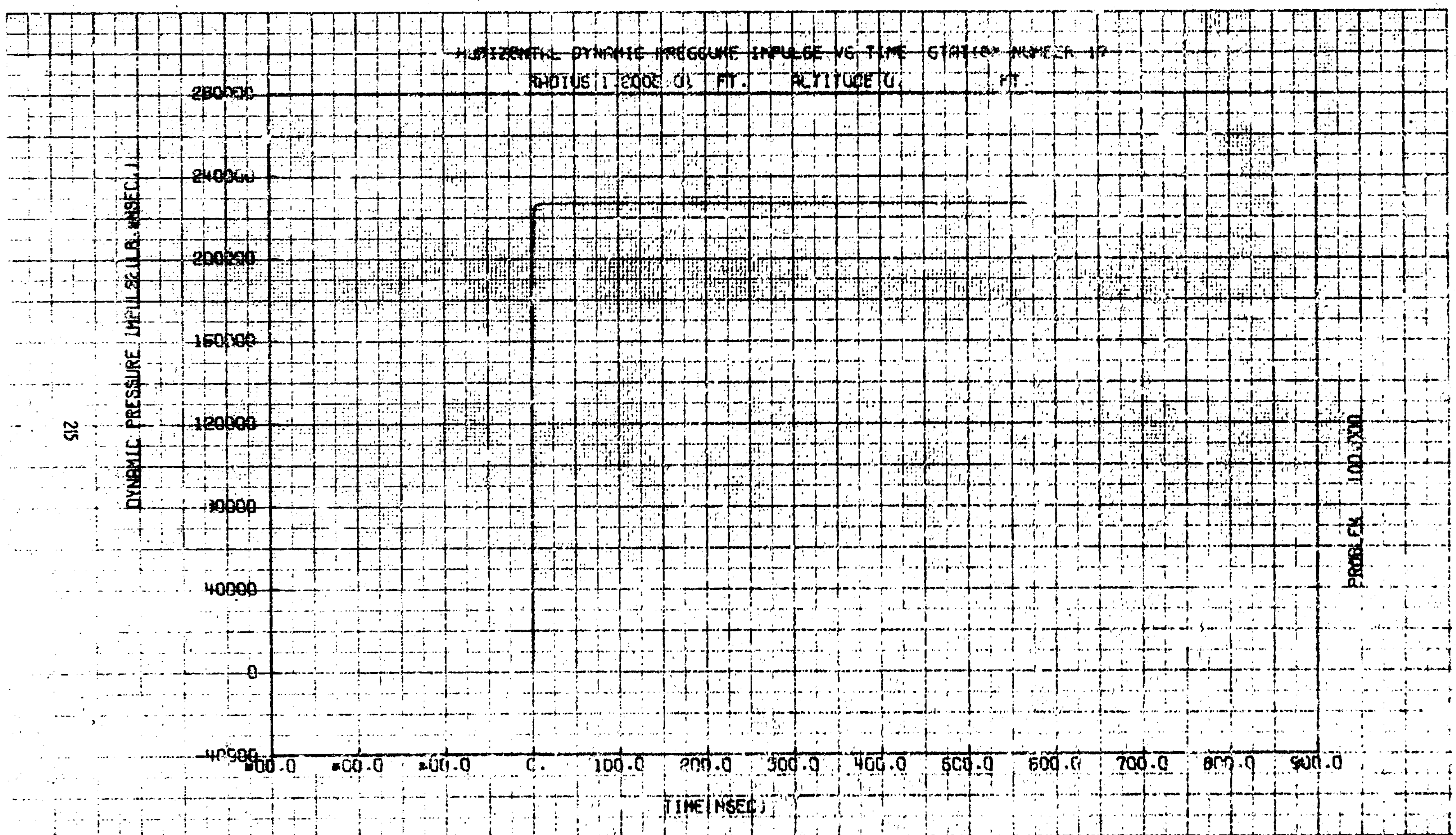

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 17
RADIUS 1.2006+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.*MSEC.)
TIME(MSEC)
PROBLEM 100.000

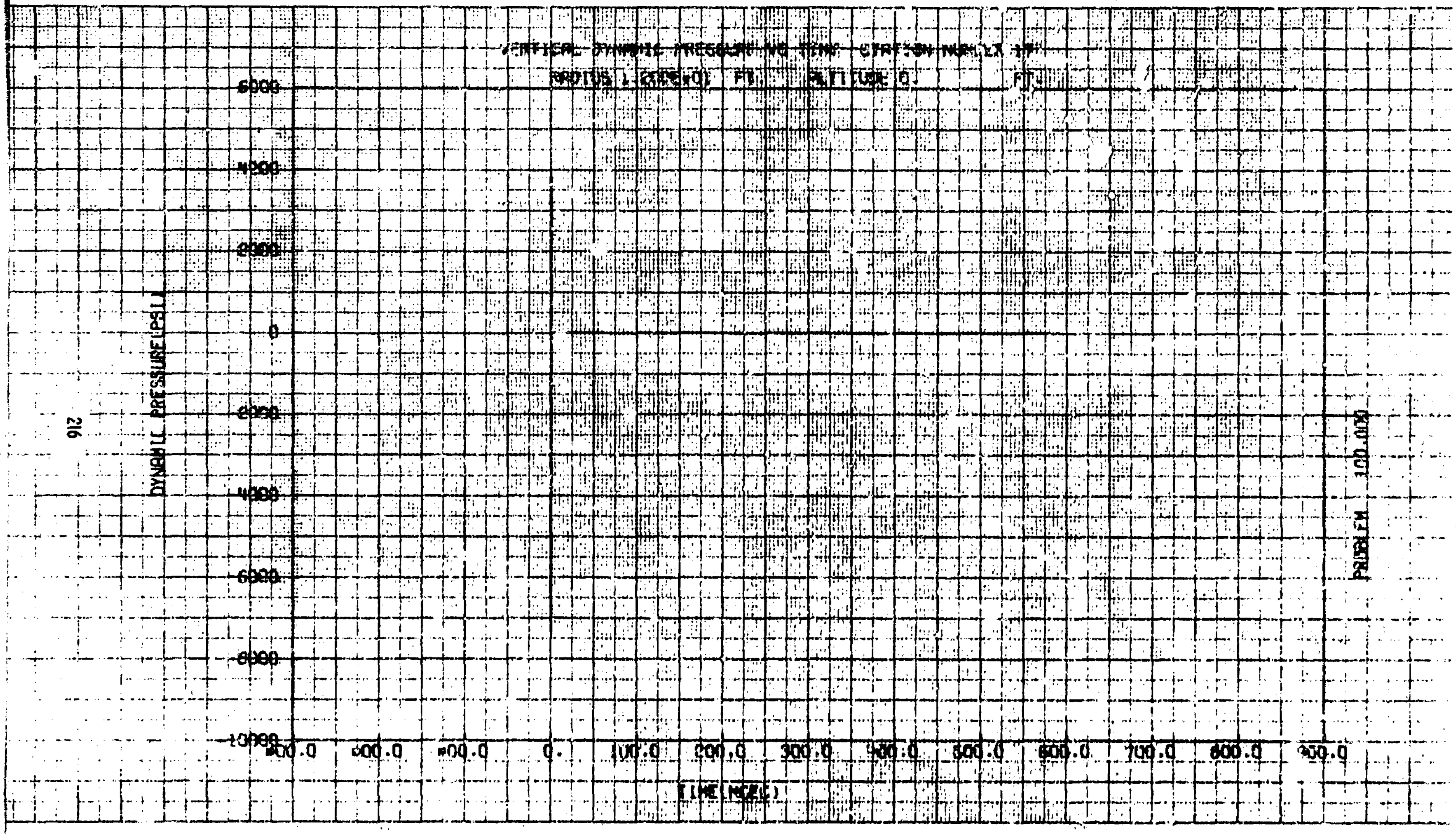


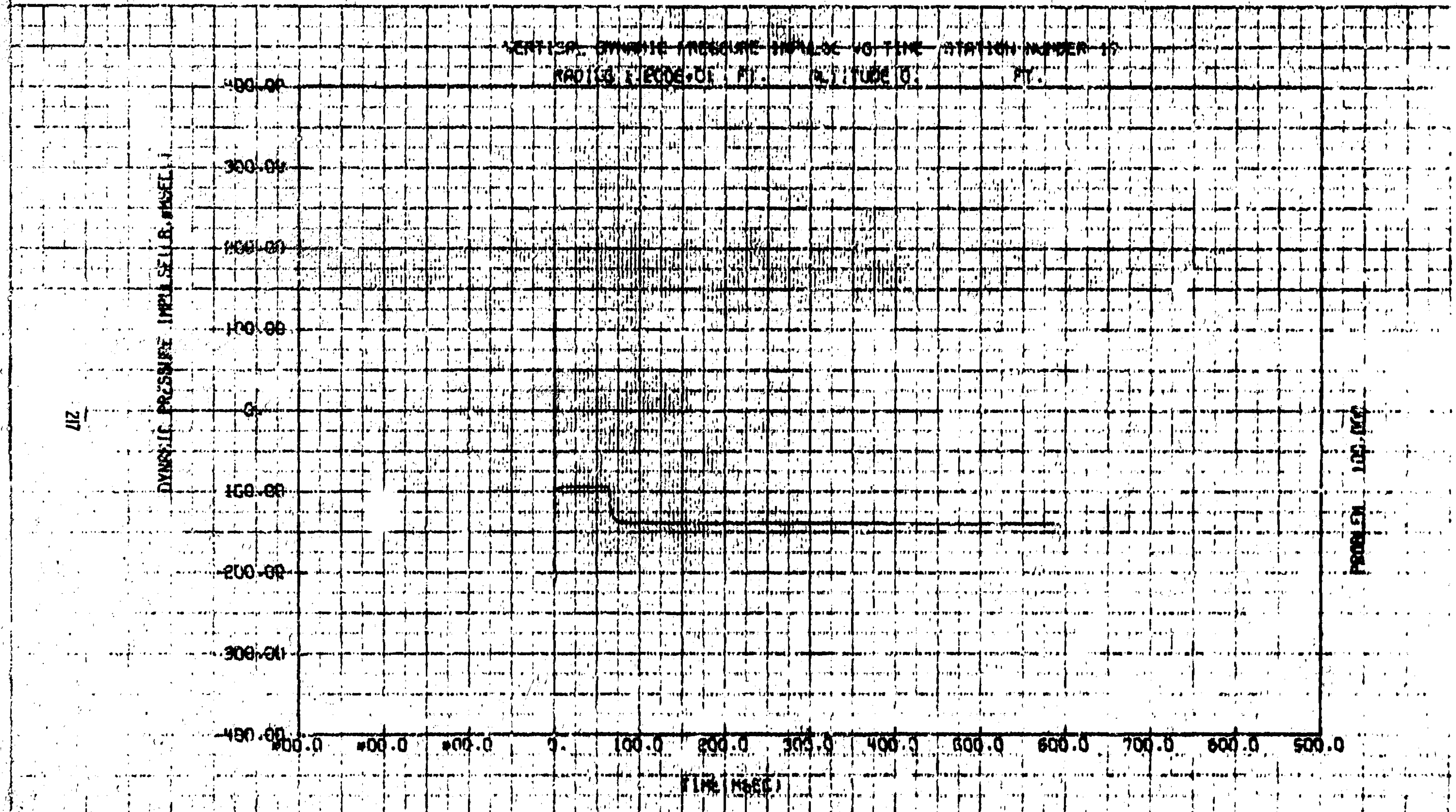
SPEED(FT/SEC)
0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM


VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 17
RADIUS 1.200E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
TIME(MSEC)
PROBLEM 100.000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0

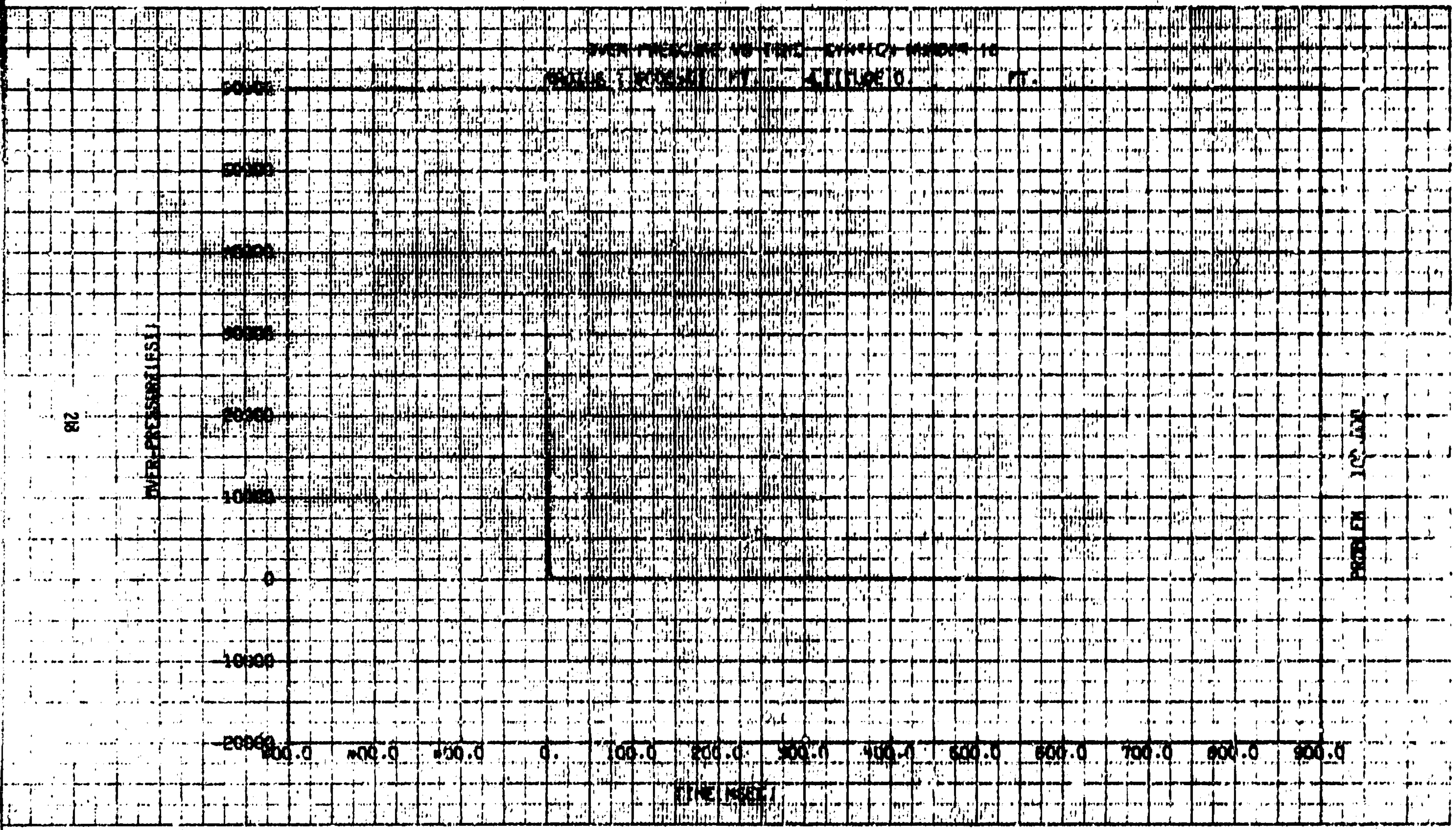

PROBLEM 100.000
0.
100.0
200.0
300.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)

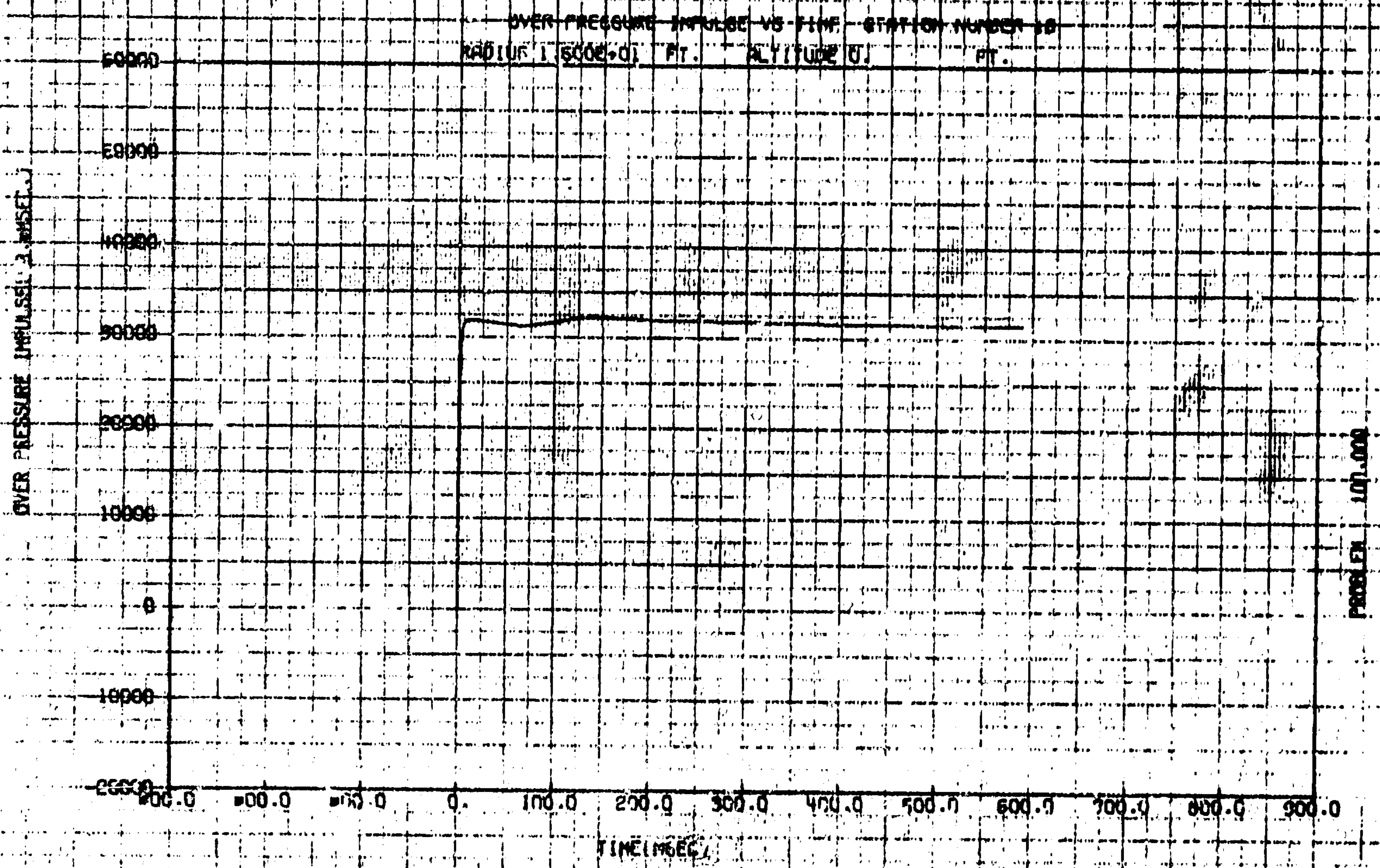

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 17
RADIUS 1.200E 01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
TIME(MSEC)
PROBLEM 100.000

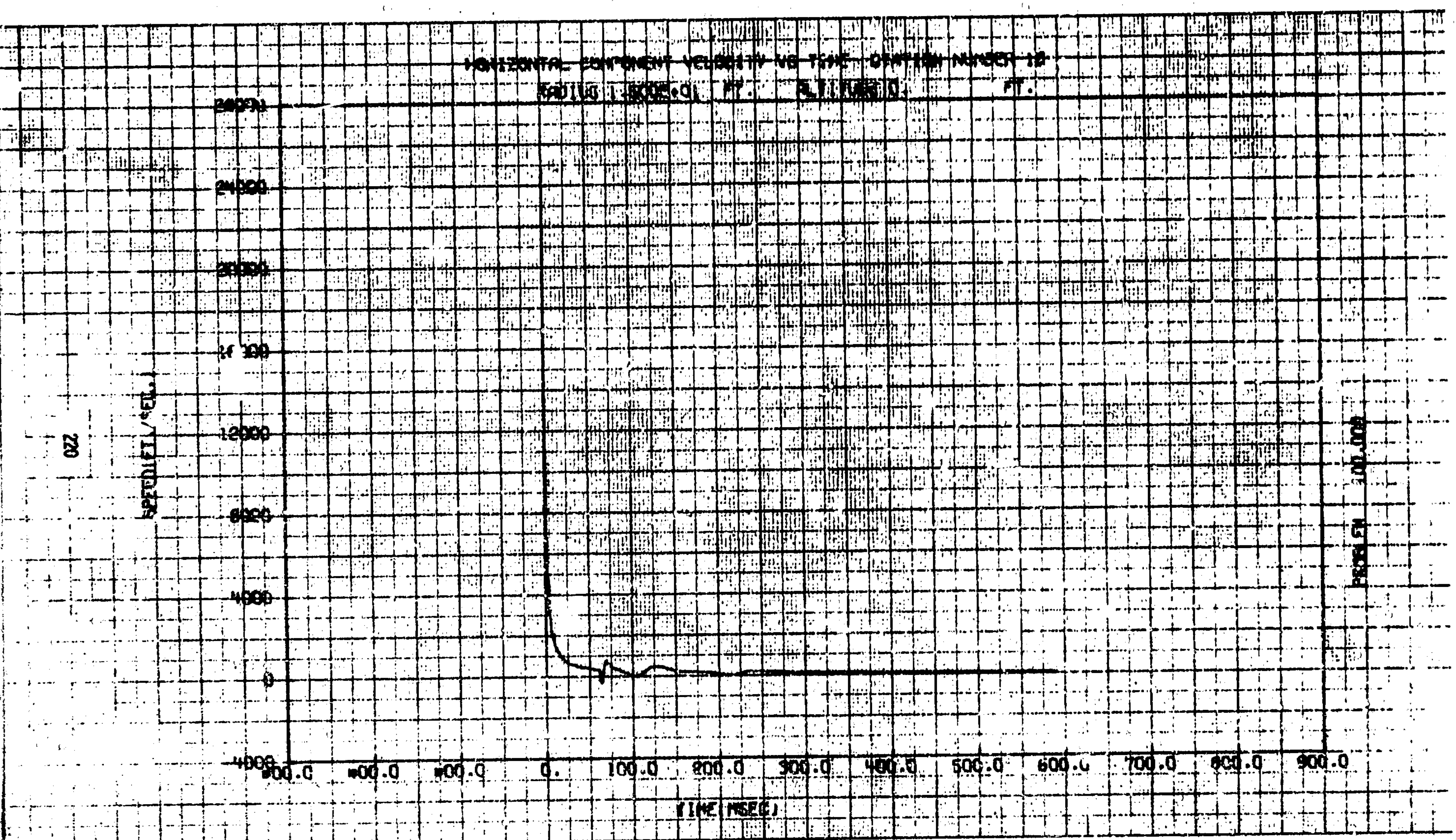

VERTICAL DYNAMIC PRESSURE VS TIME
DYNAMIC PRESSURE(PSI)
6000
4000
2000
0
-2000
-4000
-6000
-8000
-10000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

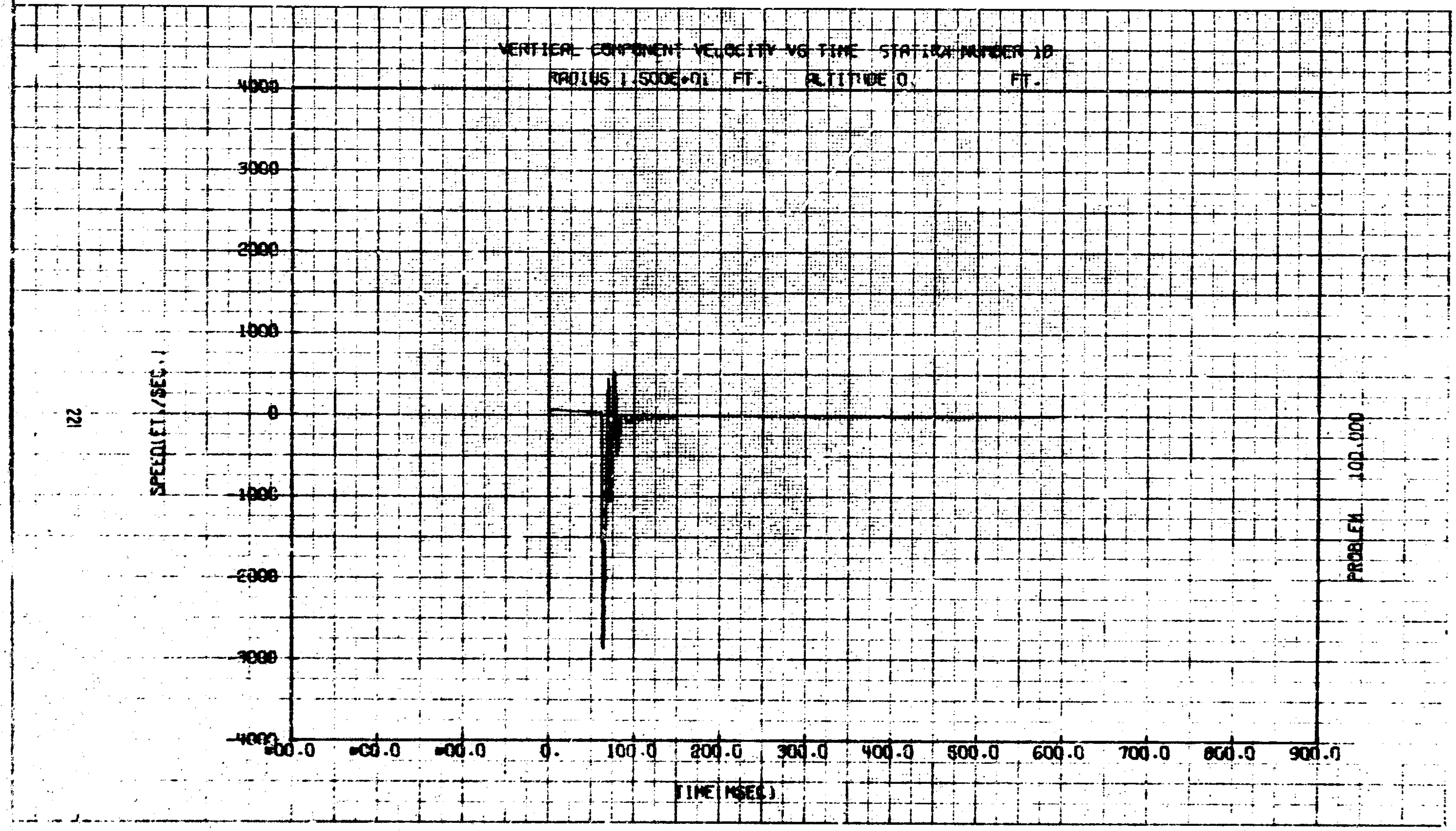


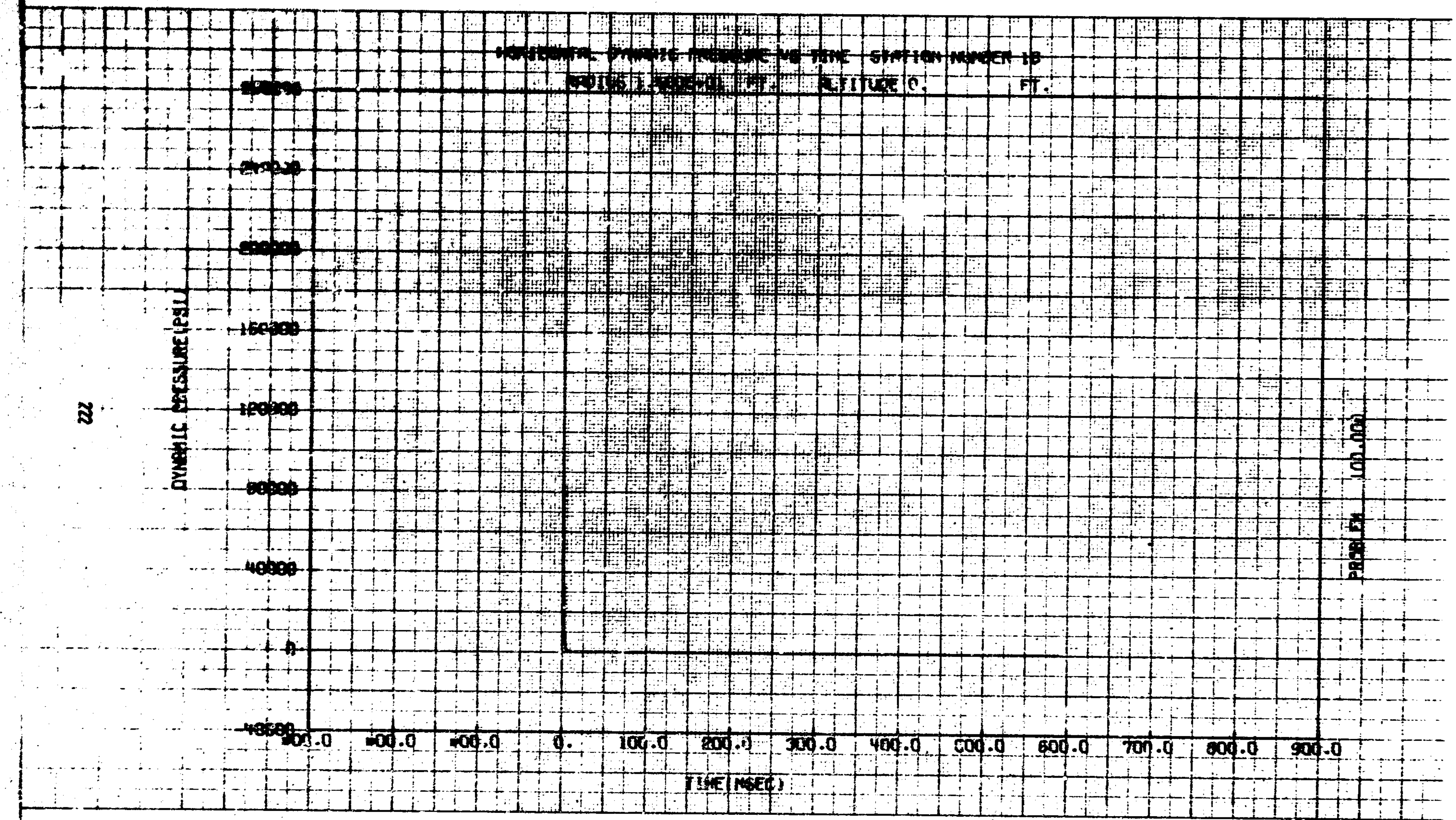
400.00
300.00
100.00
0
-200.00
-300.00
-400.00
100.0
200.0
TIME (MSEC)

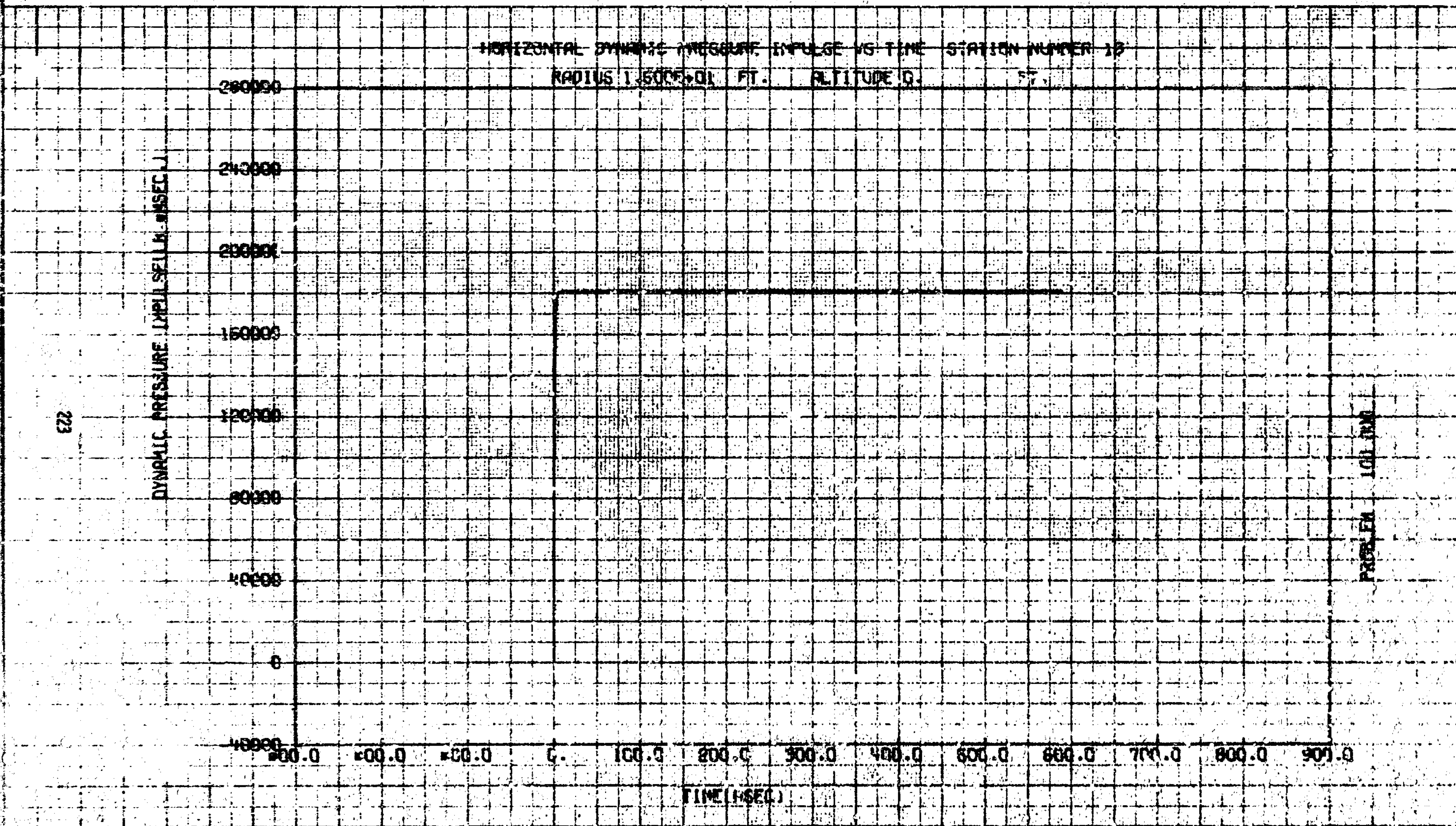

OVER-PRESSURE(PSI)
60000
50000
40000
30000
20000
10000
0
-10000
-20000
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 10C.100

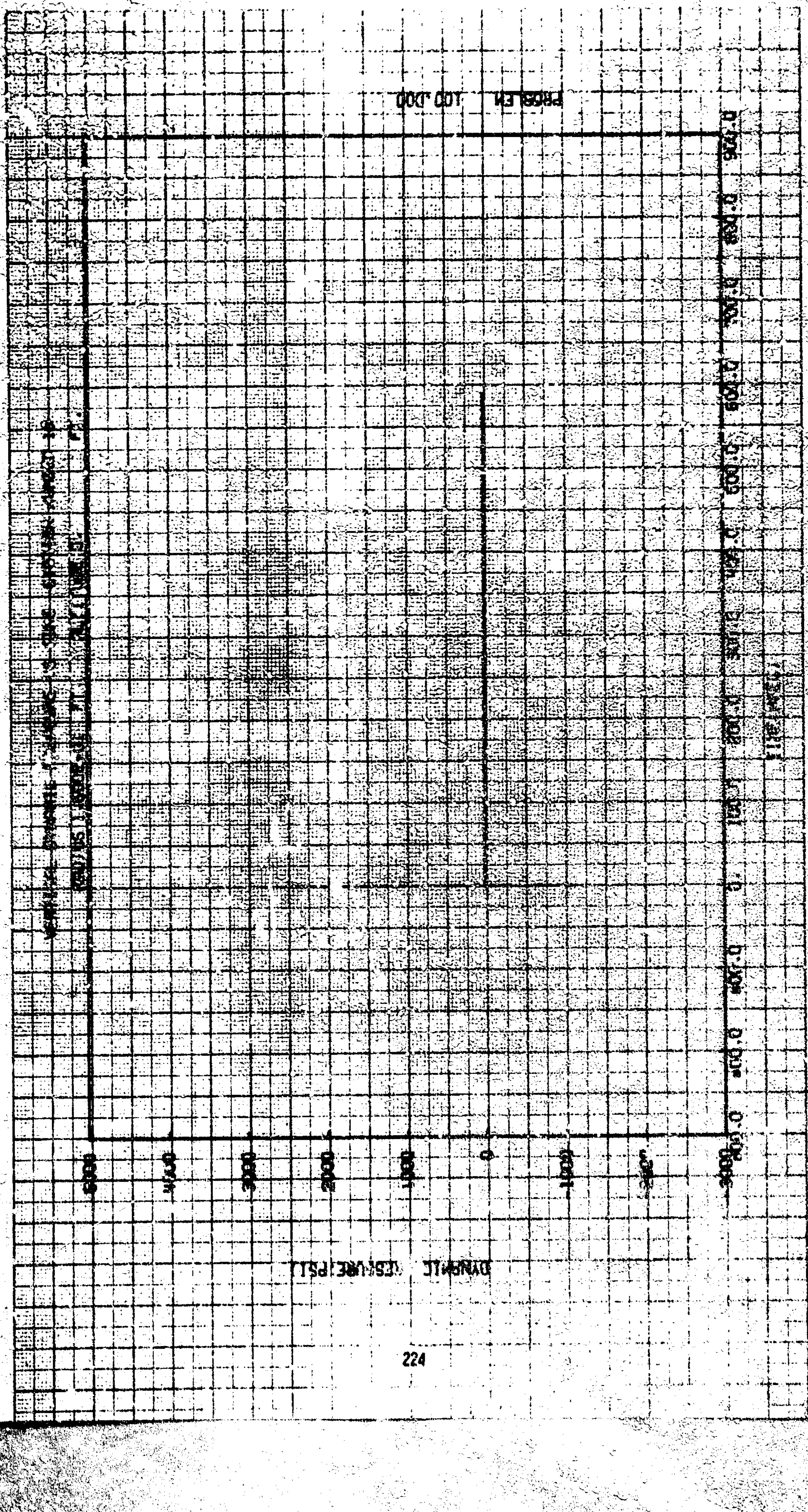

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 10
RADIUS 1.5000+01 FT. ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(PSI-MSEC)
TIME(MSEC)
PROBLEM 101.000

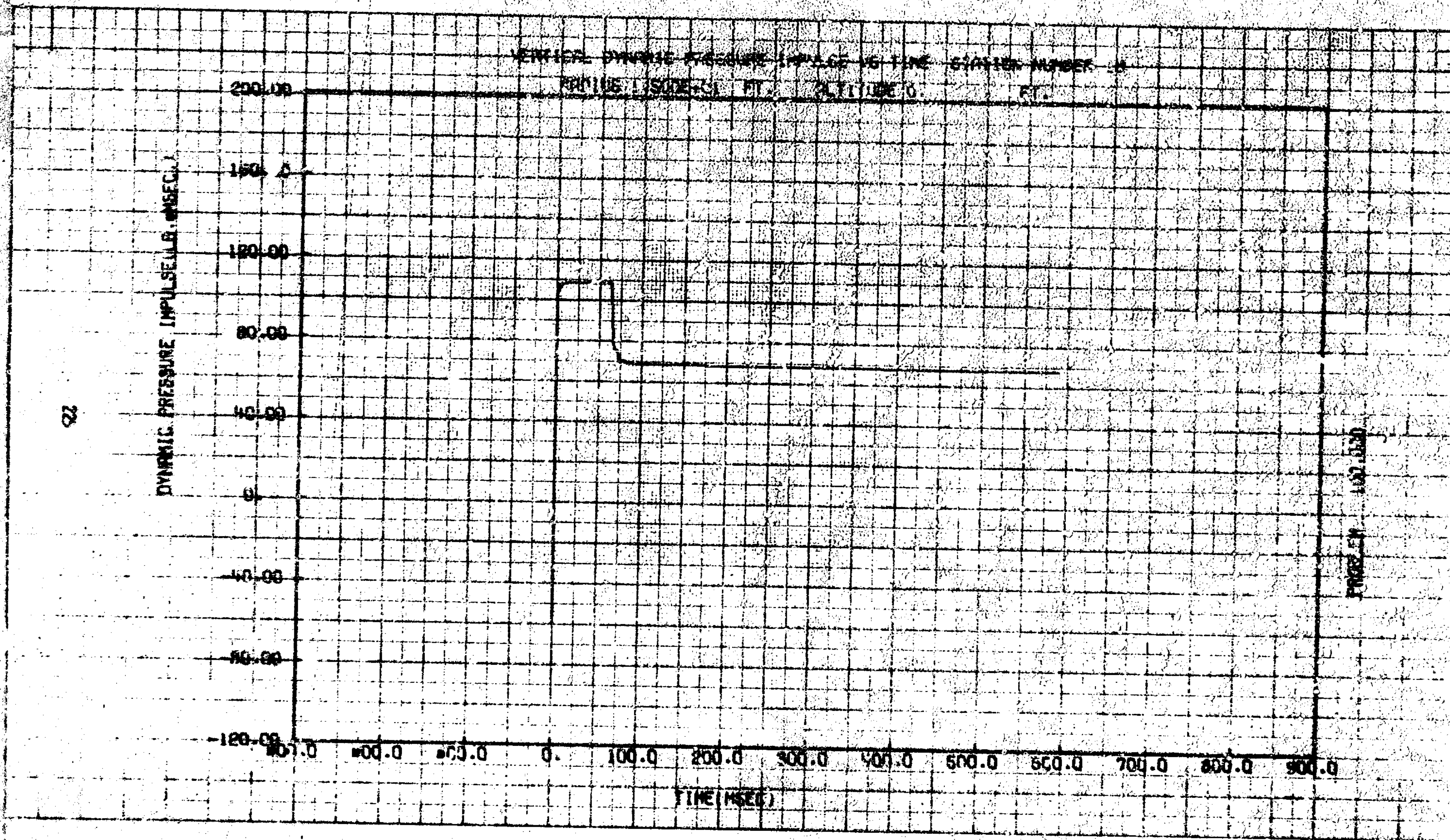

HORIZONTAL COMPONENT VELOCITY VS TIME
TIME MSEC
100.0
200.0
500.0
600.0
700.0
900.0
24000
20000
12000
0
-4000

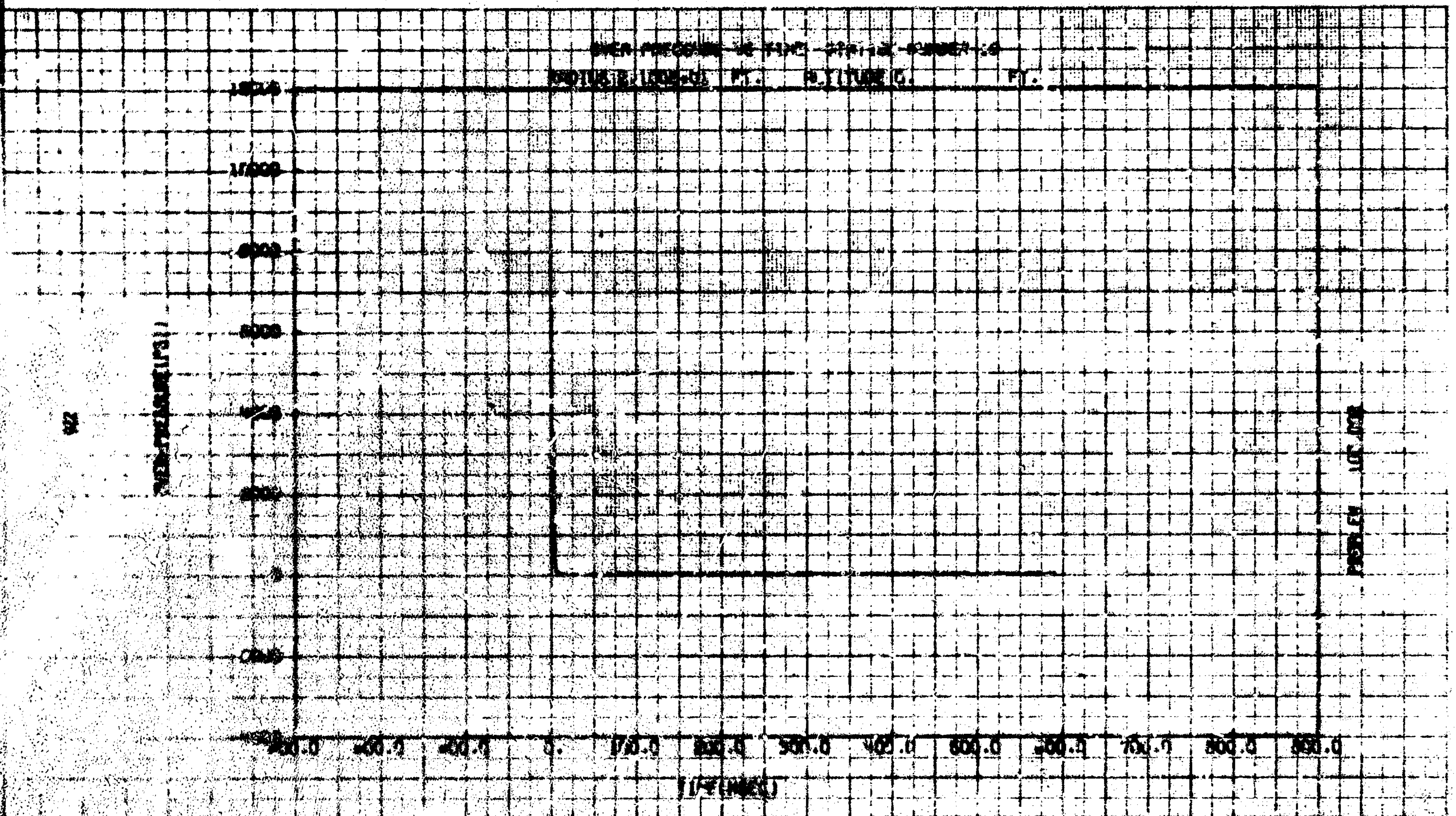

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 10
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000


ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
160000
120000
80000
40000
0
0.
100.0
200.0
300.0
400.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM

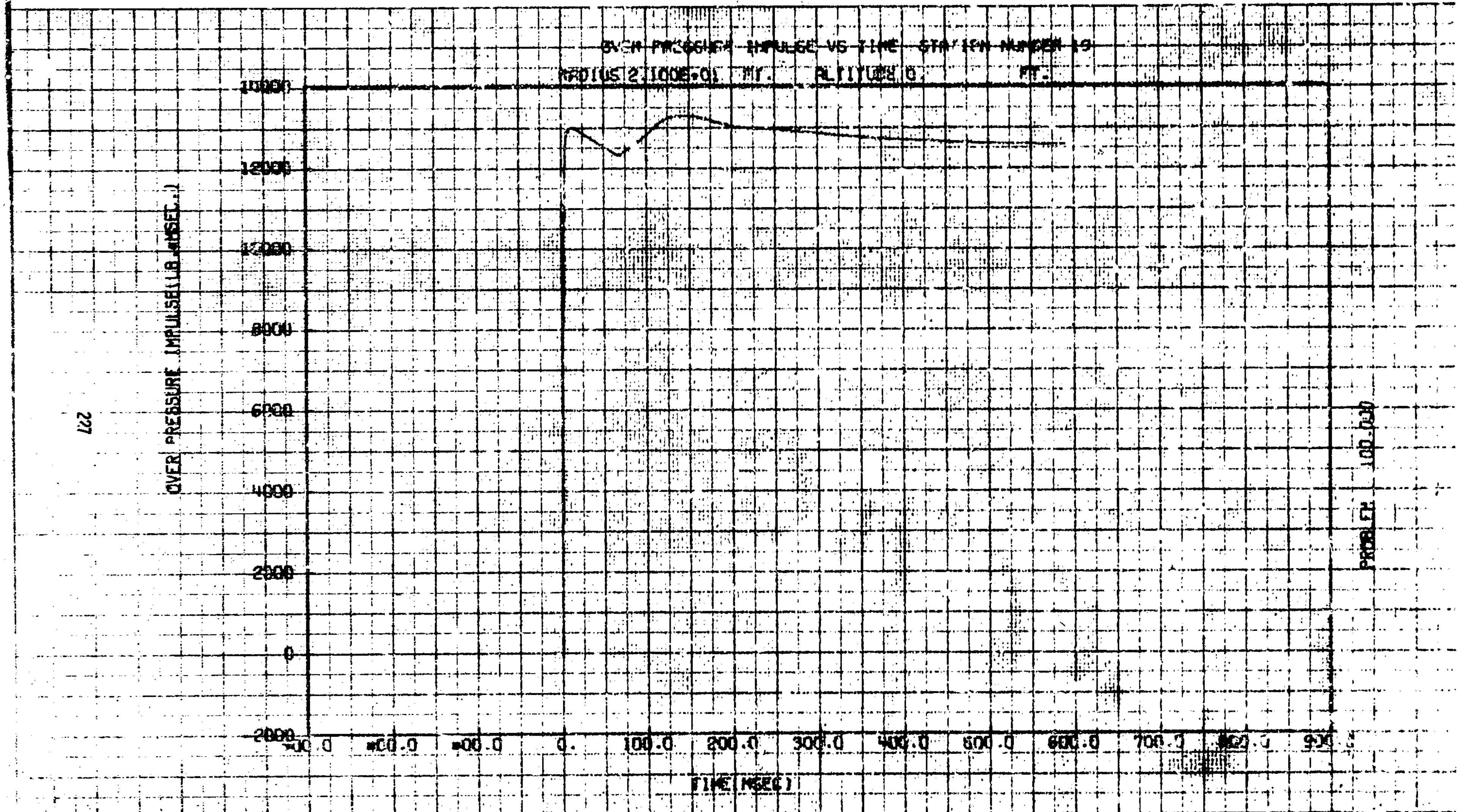

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 13
RADIUS 1.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB-MSEC.)
TIME(MSEC)
PROBLEM 101.000
280000
240000
200000
160000
120000
80000
40000
0
-40000
100.0
200.0
300.0
400.0
600.0
800.0
800.0
900.0

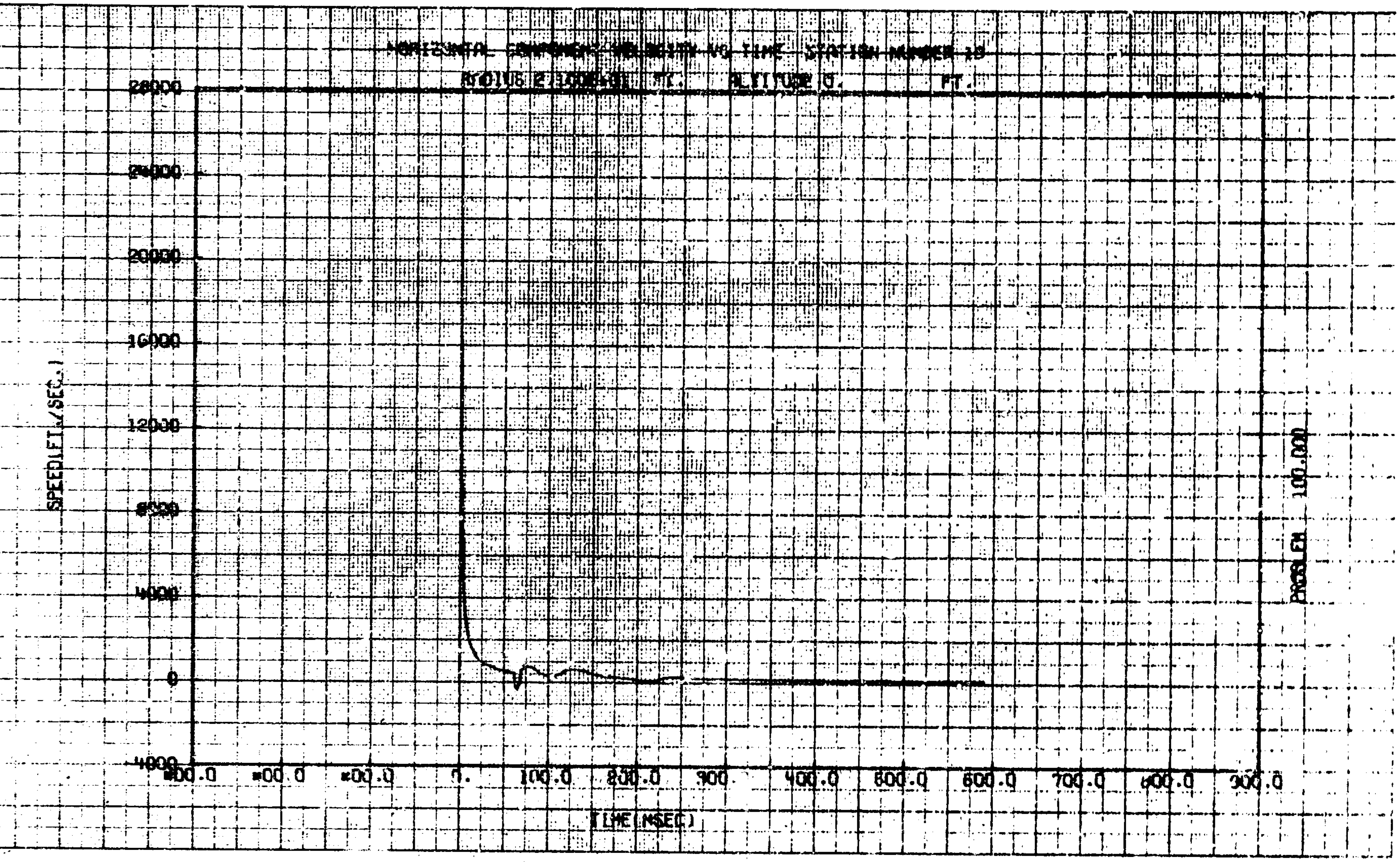


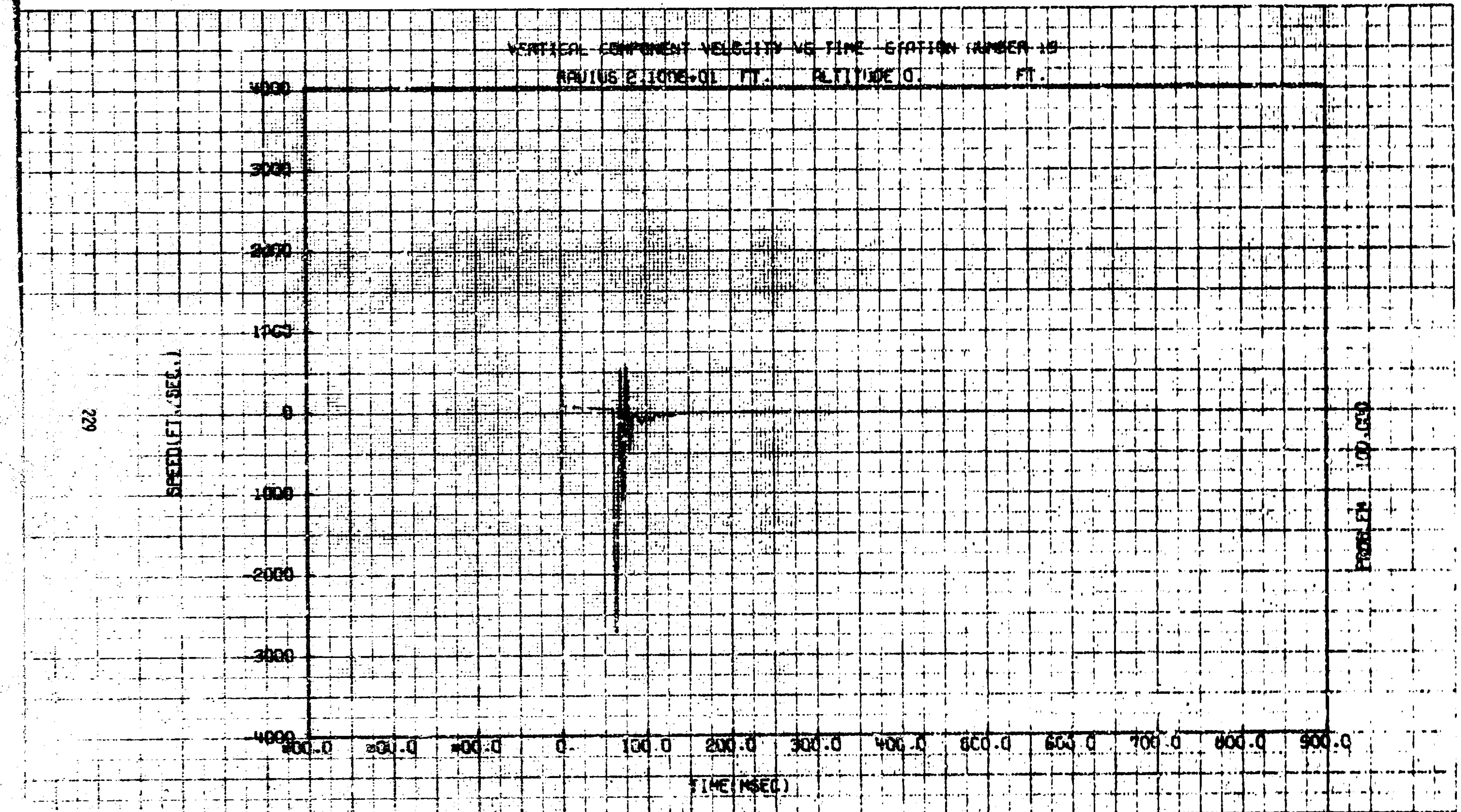

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
TIME(MSEC)
200.00
120.00
80.00
40.00
0.
-40.00
-120.00
0.
100.0
200.0
300.0
400.0
600.0
700.0
800.0
900.0

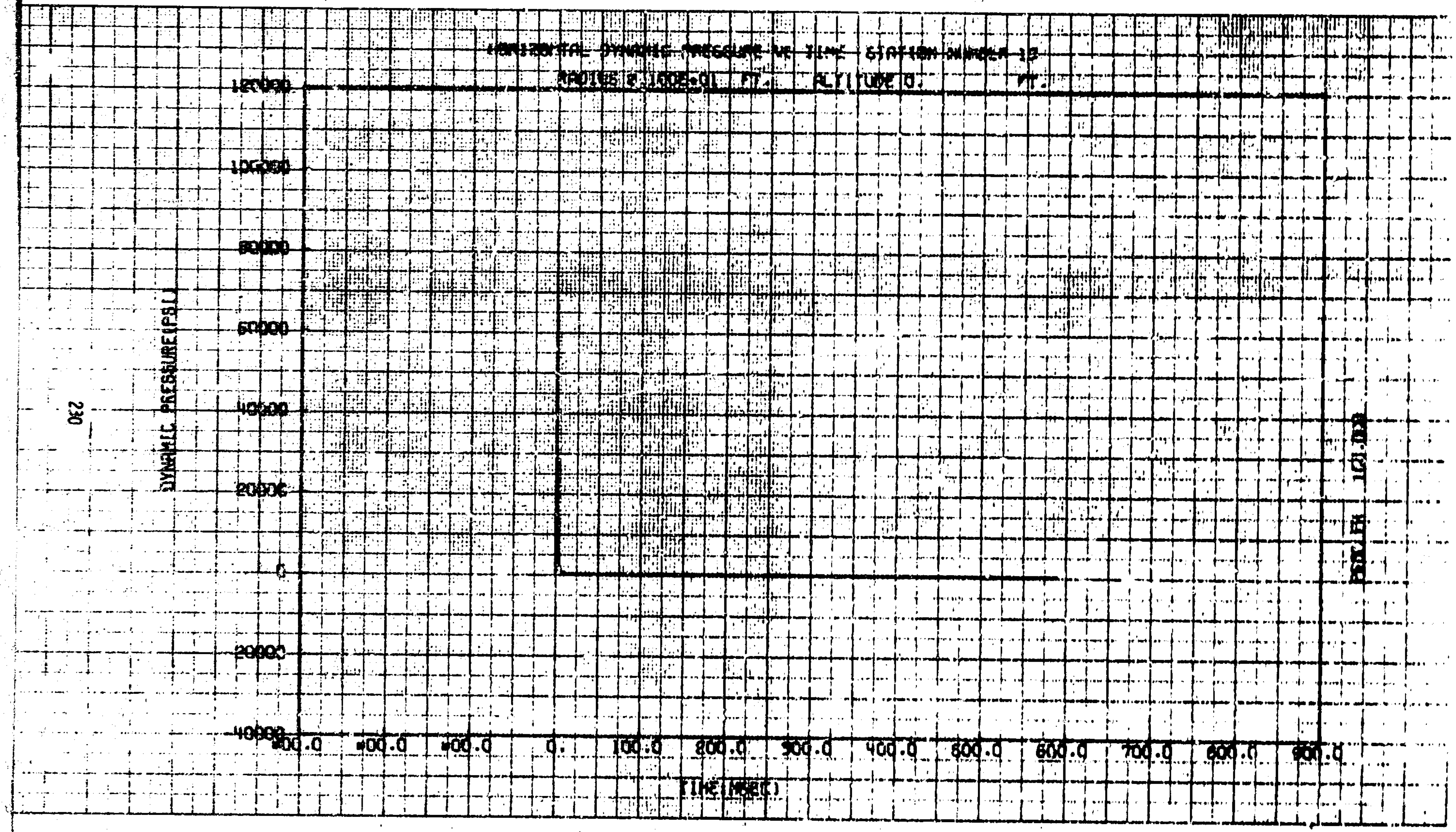


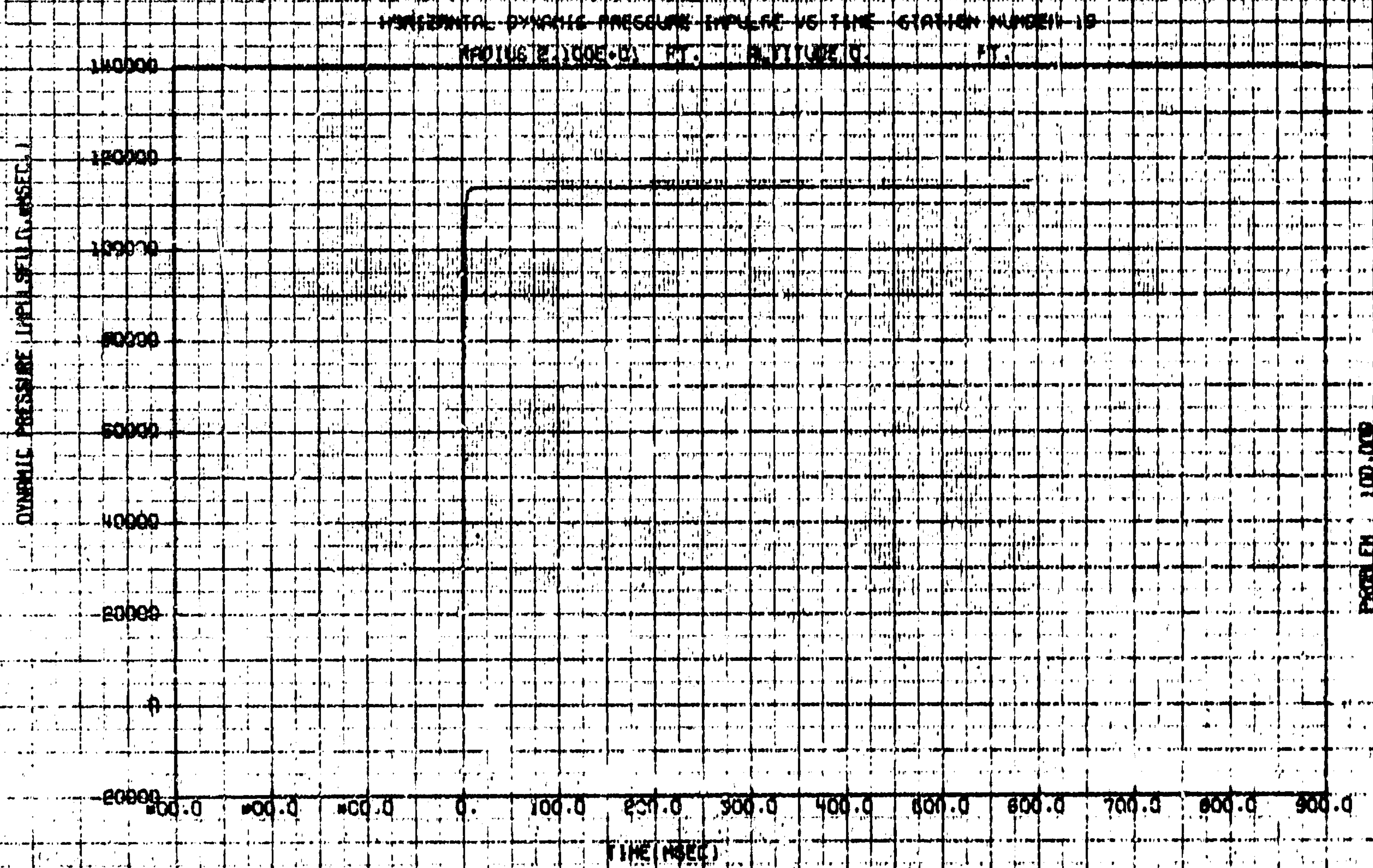
FT.
FT.
TIME(MSEC)


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
OVER PRESSURE IMPULSE(LB.*MSEC.)
12000
8000
6000
4000
2000
0
-2000
0.
100.0
200.0
300.0
400.0
600.0
700.0
900
TIME(MSEC)

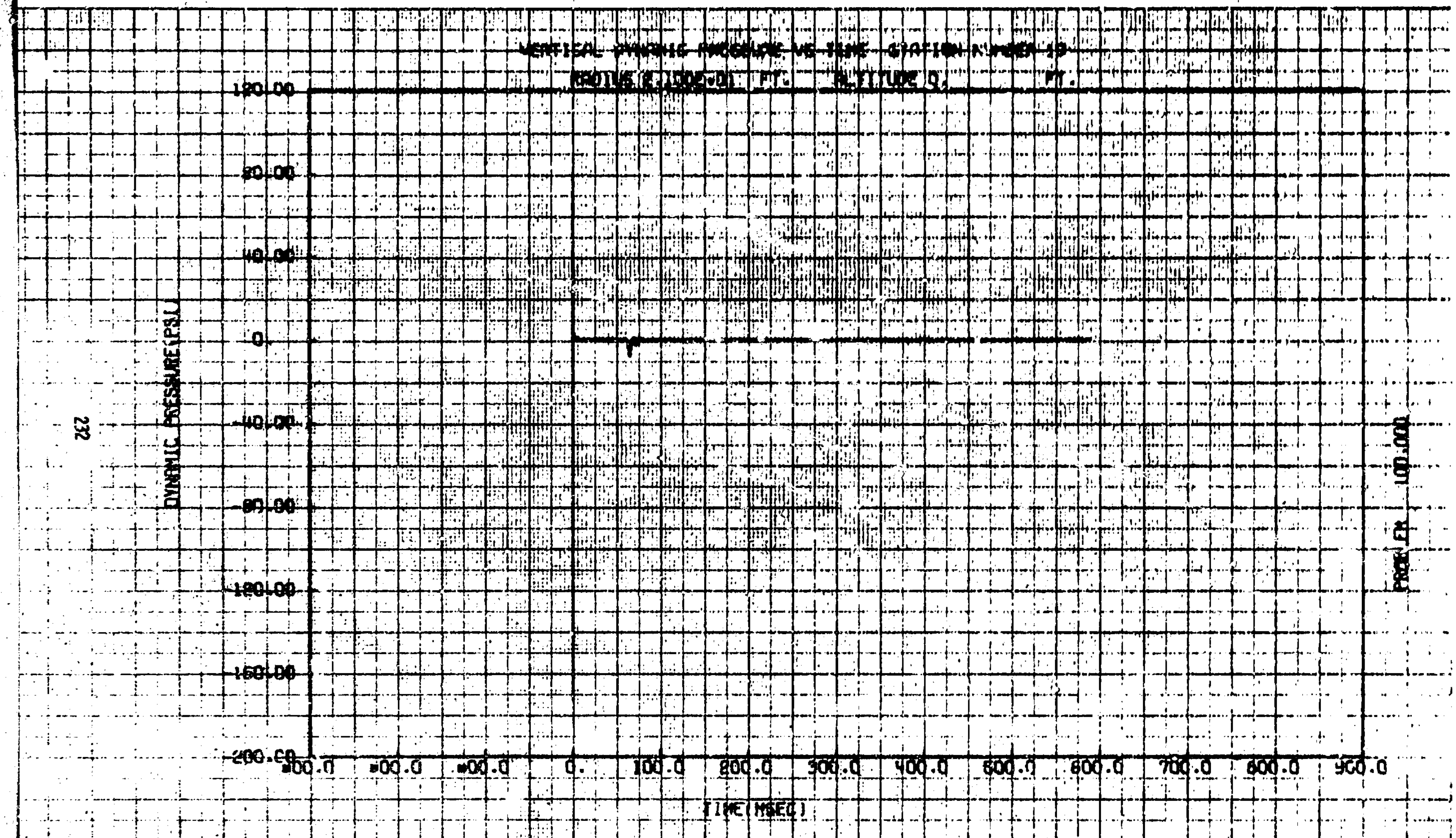

SPEED(FT./SEC.)
28000
24000
20000
16000
12000
4000
0
TIME(MSEC)
PROBLEM 100.000

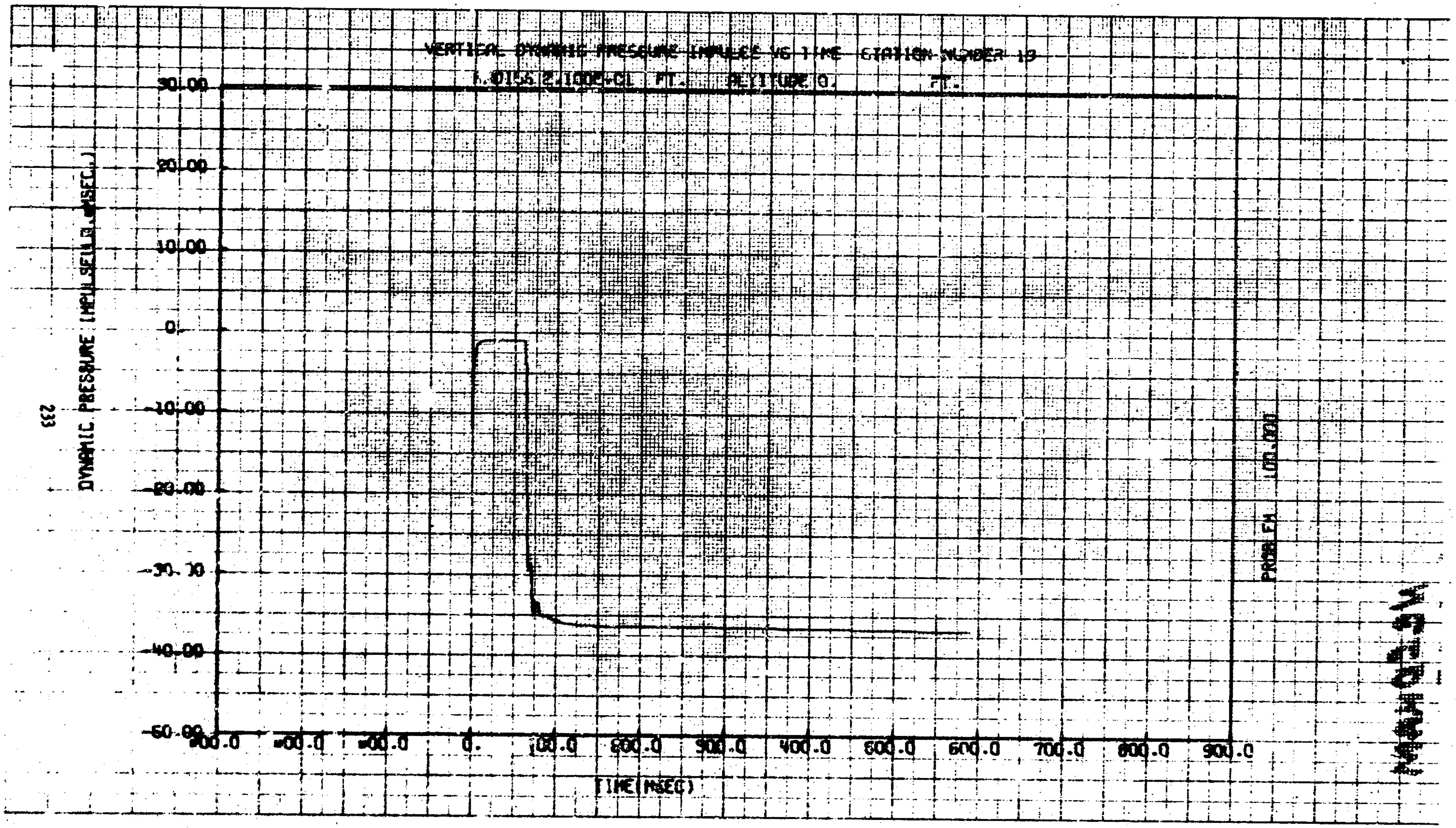

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 19
RADIUS 2.100E+01 FT. ALTITUDE 0. FT.
4000
3000
2000
1000
0
1000
-2000
-3000
-4000
0.
100.0
200.0
300.0
400.0
600.0
700.0
800.0
900.0
TIME(MSEC)
SPEED(FT./SEC.)
PROBLEM 100.000

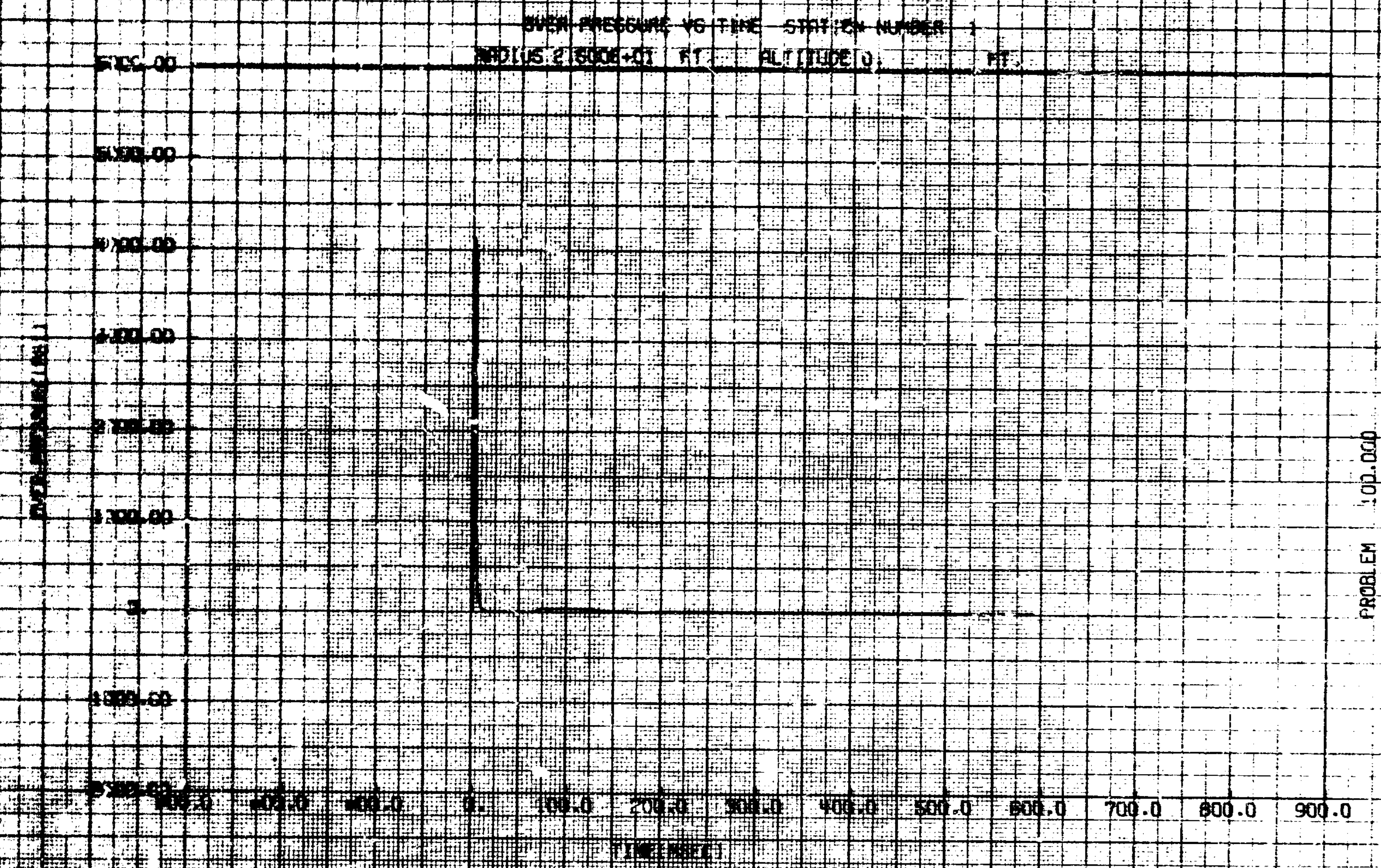

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 13
RADIUS 8.100E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
120000
100000
80000
60000
40000
20000
0
-20000
-40000
0.
100.0
300.0
400.0
700.0
TIME(MSEC)

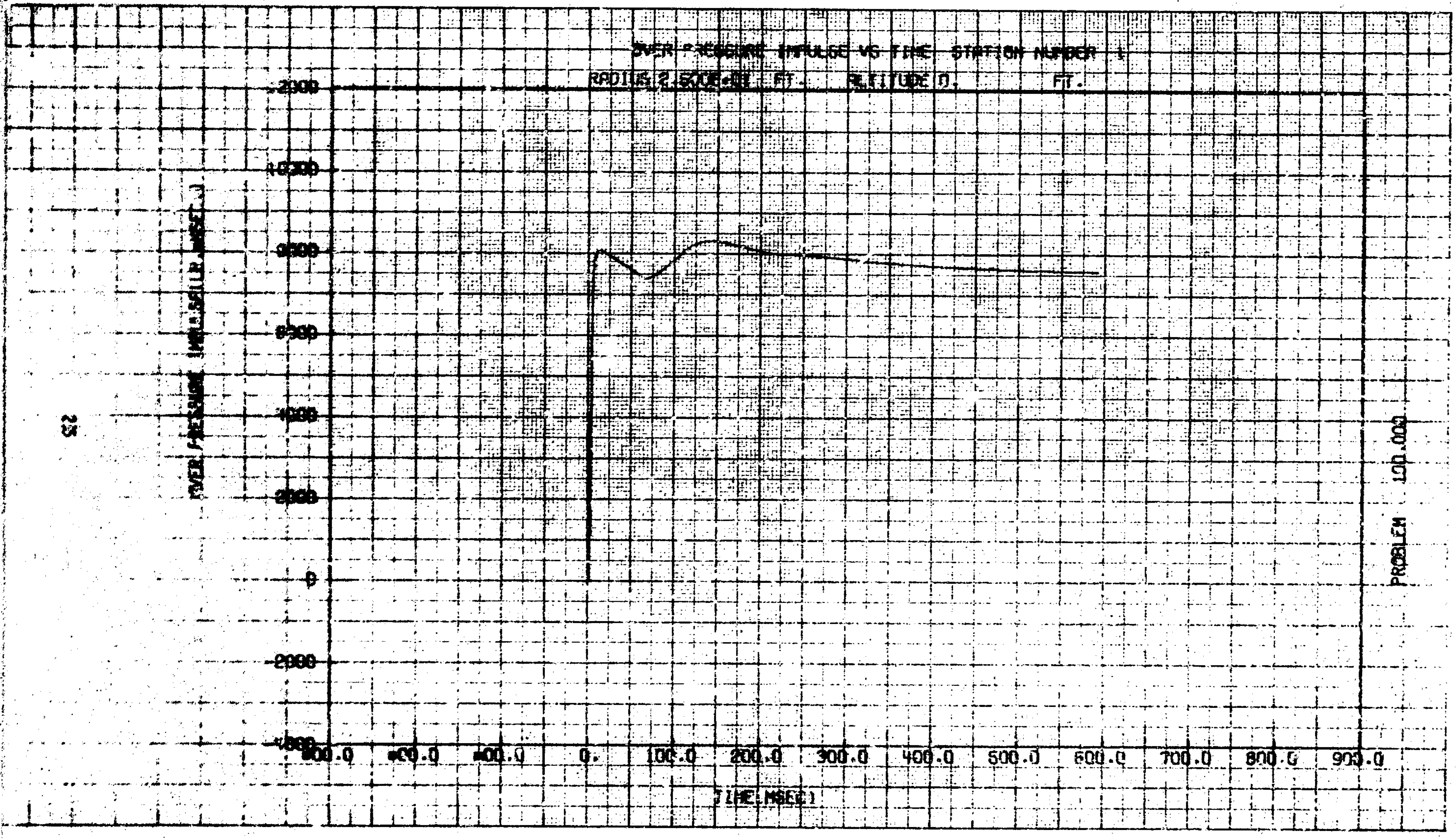


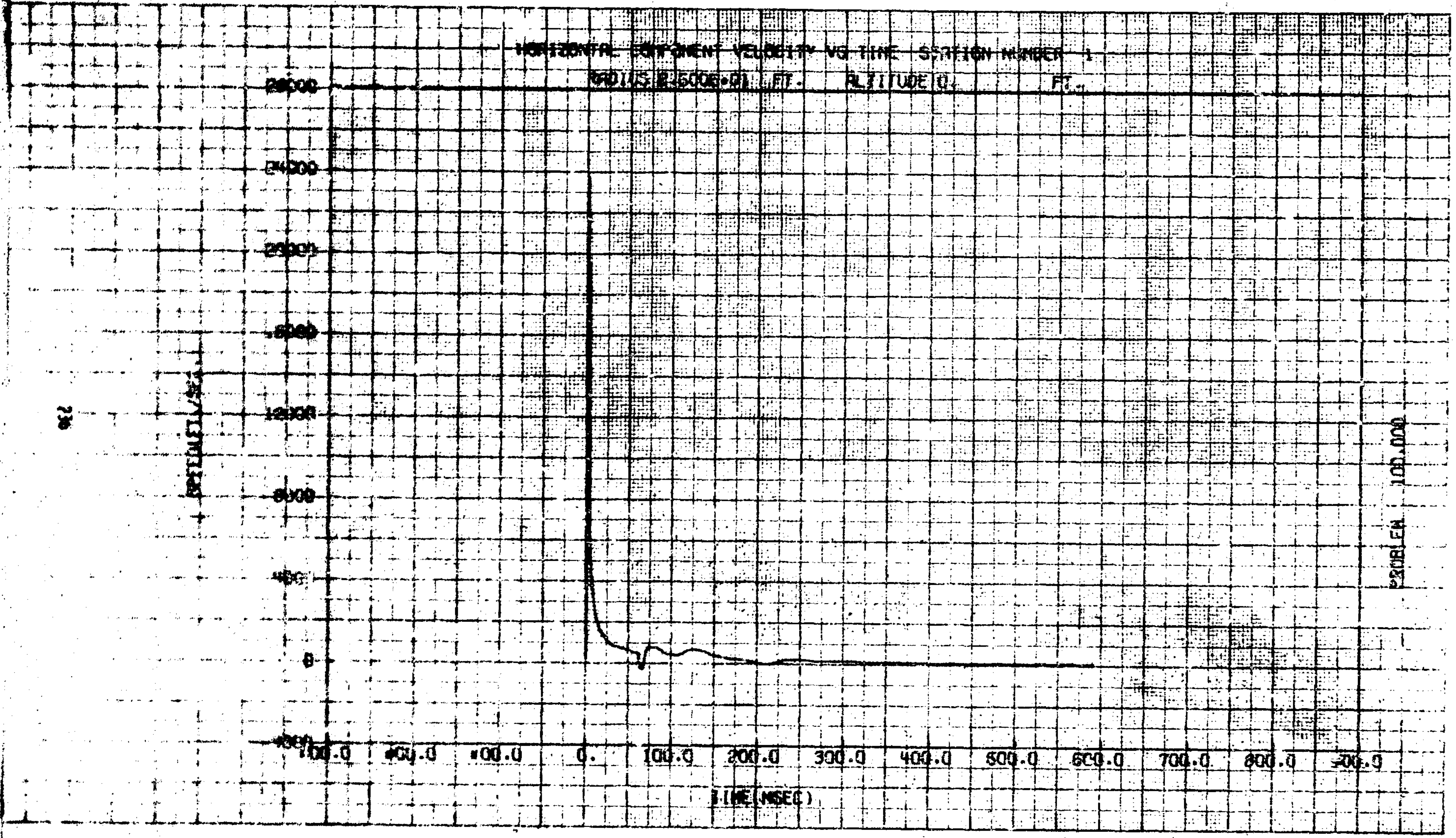
140000
120000
80000
60000
40000
20000
0
-20000
100.0
300.0
400.0
600.0
900.0
TIME(MSEC)

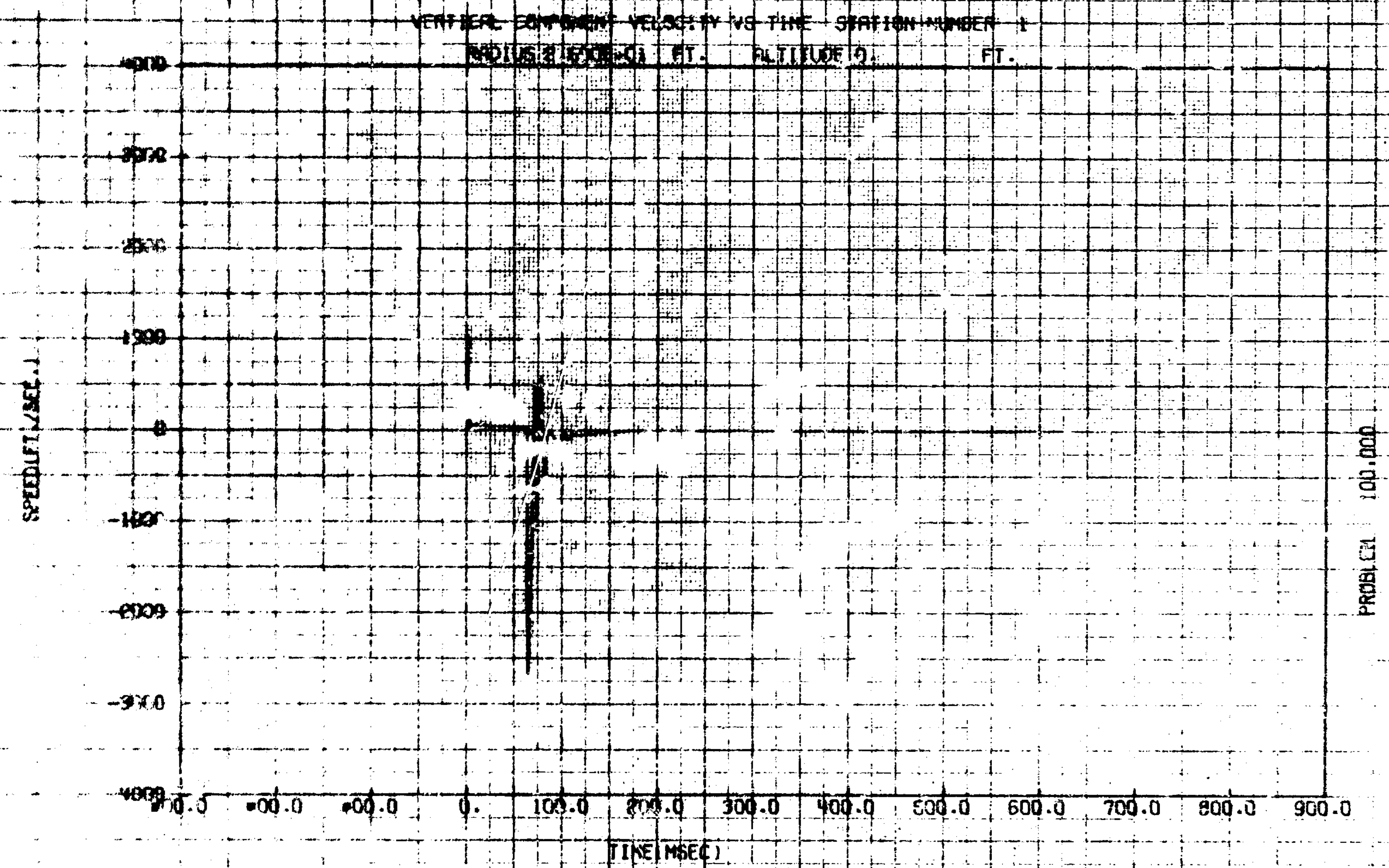

DYNAMIC PRESSURE(PSI)
120.00
80.00
40.00
0
-40.00
-80.00
-120.00
-160.00
-200.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
100.000


VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 13
FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
30.00
20.00
10.00
0.
-10.00
-20.00
-30.00
-40.00
-50.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

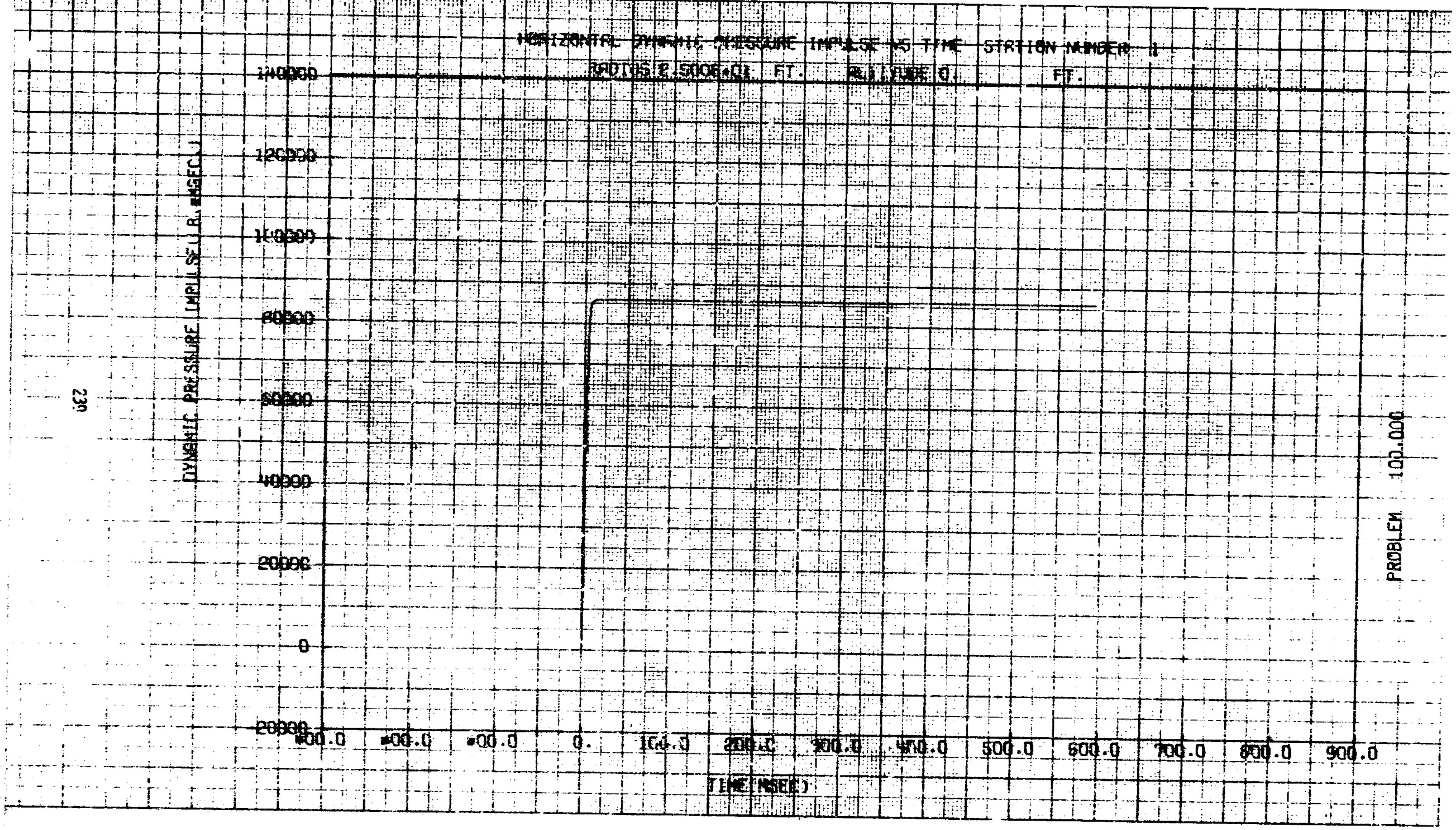

OVER PRESSURE VS TIME STATION NUMBER 1
RADIUS 2.500E+01 FT. ALTITUDE 0. FT.
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
PROBLEM 100.000

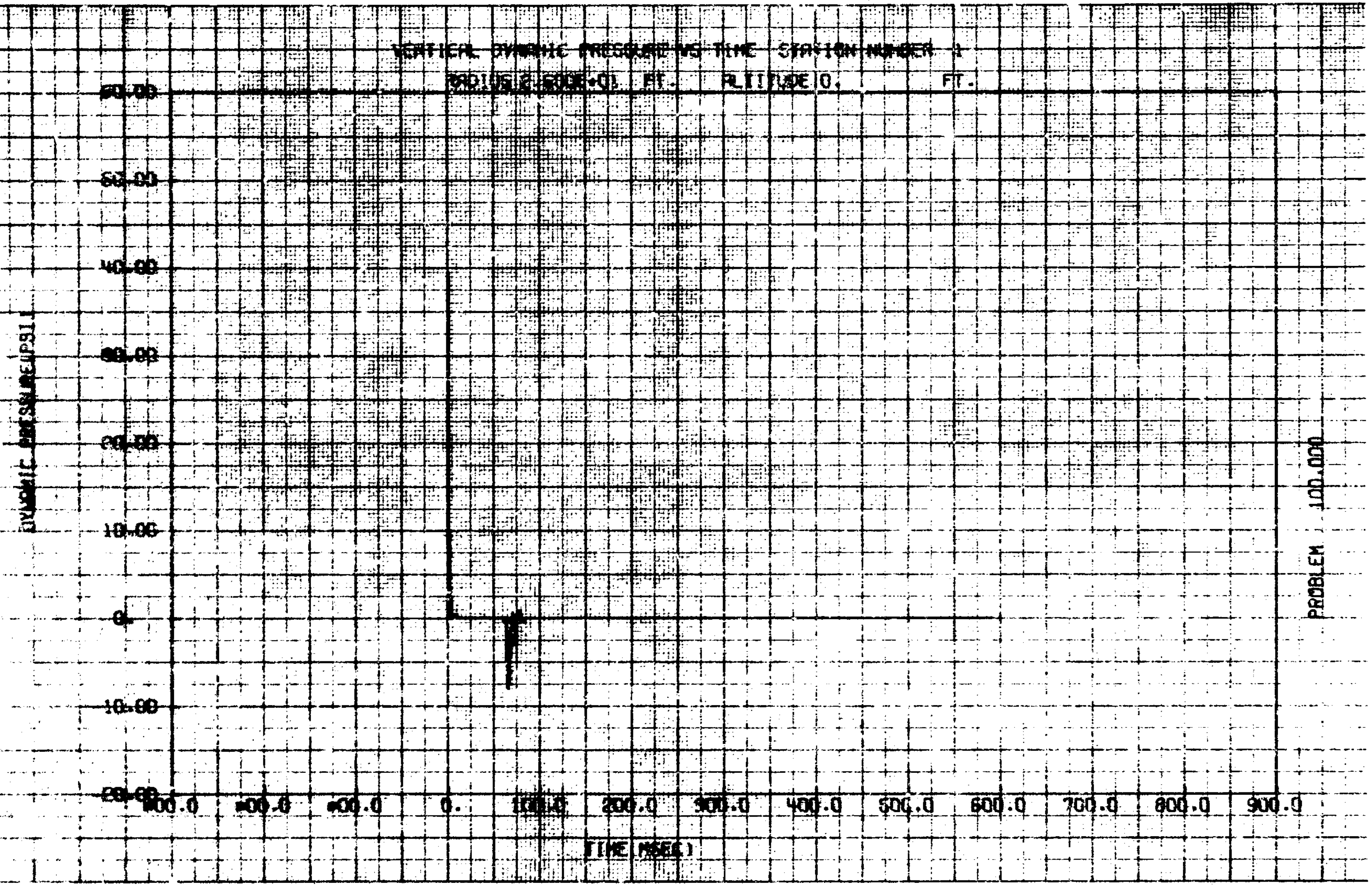

OVER-PRESSURE IMPULSE VS TIME STATION NUMBER 1
RADIUS FT. ALTITUDE 0. FT.
0
-2000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

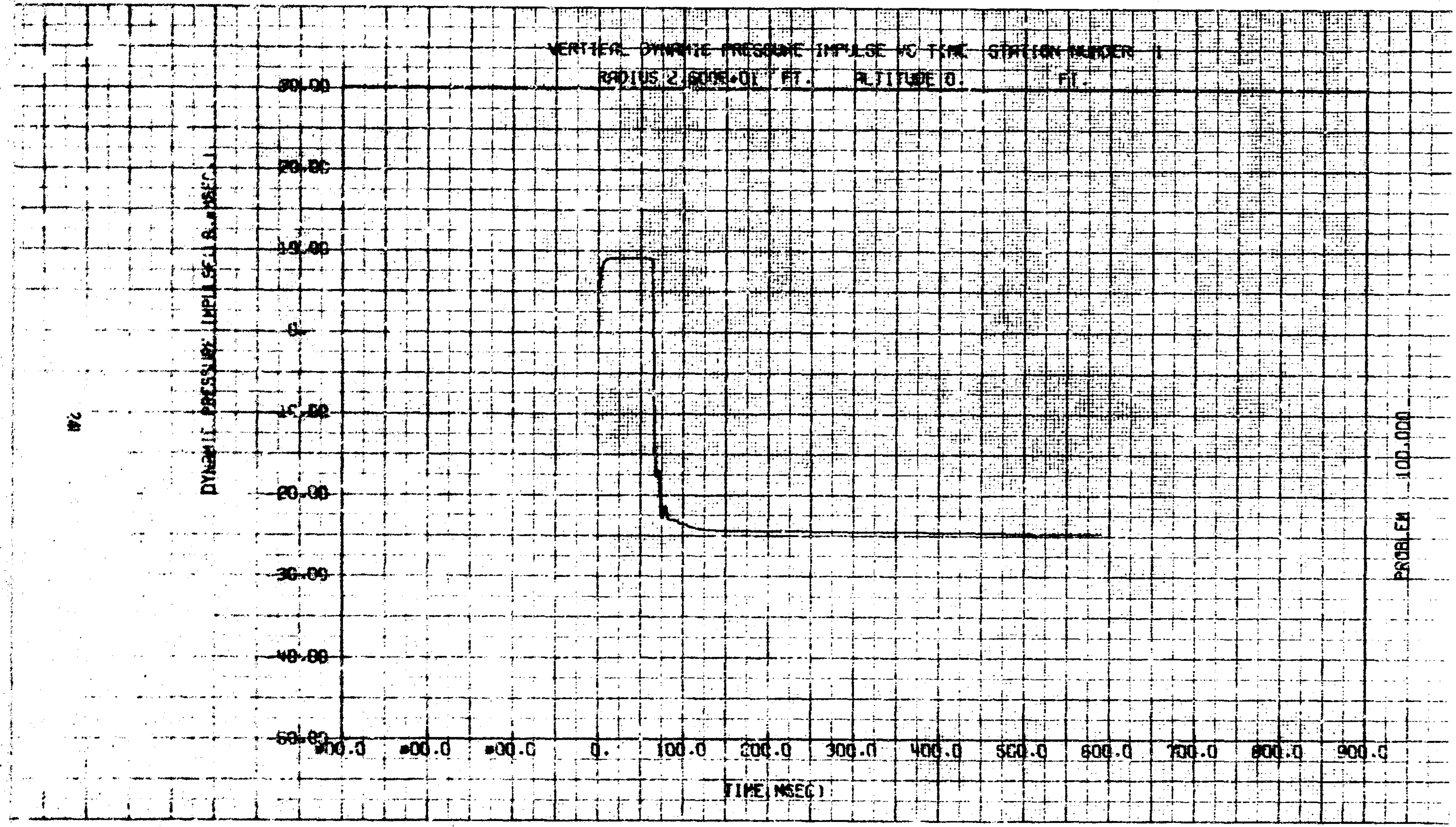

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 1
RADIUS 8.5000E+01 FT. ALTITUDE 0. FT.
VELOCITY(FT/SEC)
TIME(MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
PROBLEM 100,000


VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 1
RADIUS FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
TIME(MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
0
-3000
PROBLEM 100.000

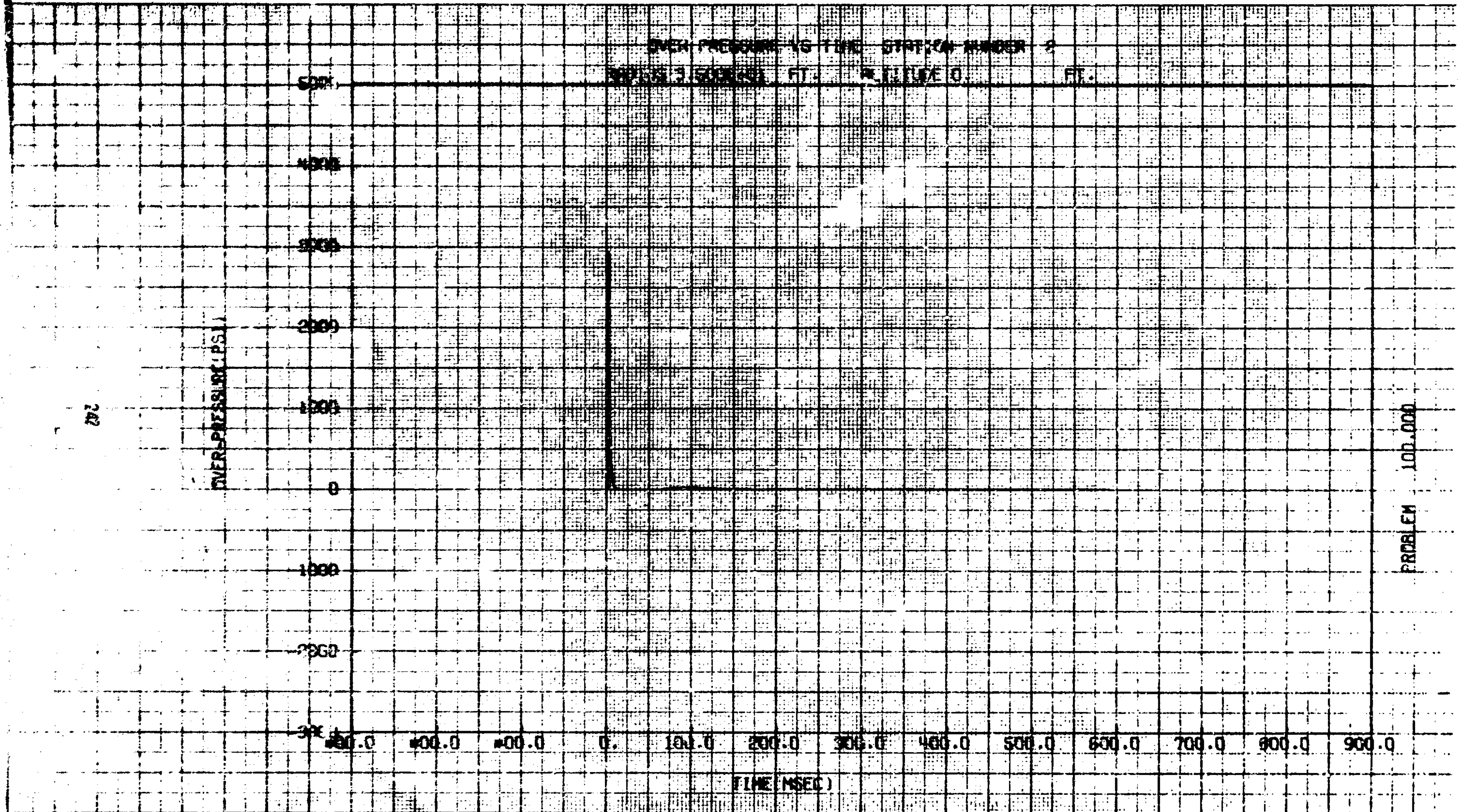

DYNAMIC PRESSURE VS TIME STATION NUMBER 1
RADIUS 2.600E+01 FT. ALTITUDE 0 FT.
70000
60000
50000
40000
30000
20000
10000
0
-10000
-200.0
400.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
DYNAMIC PRESSURE (PSI)
PROBLEM 100.000

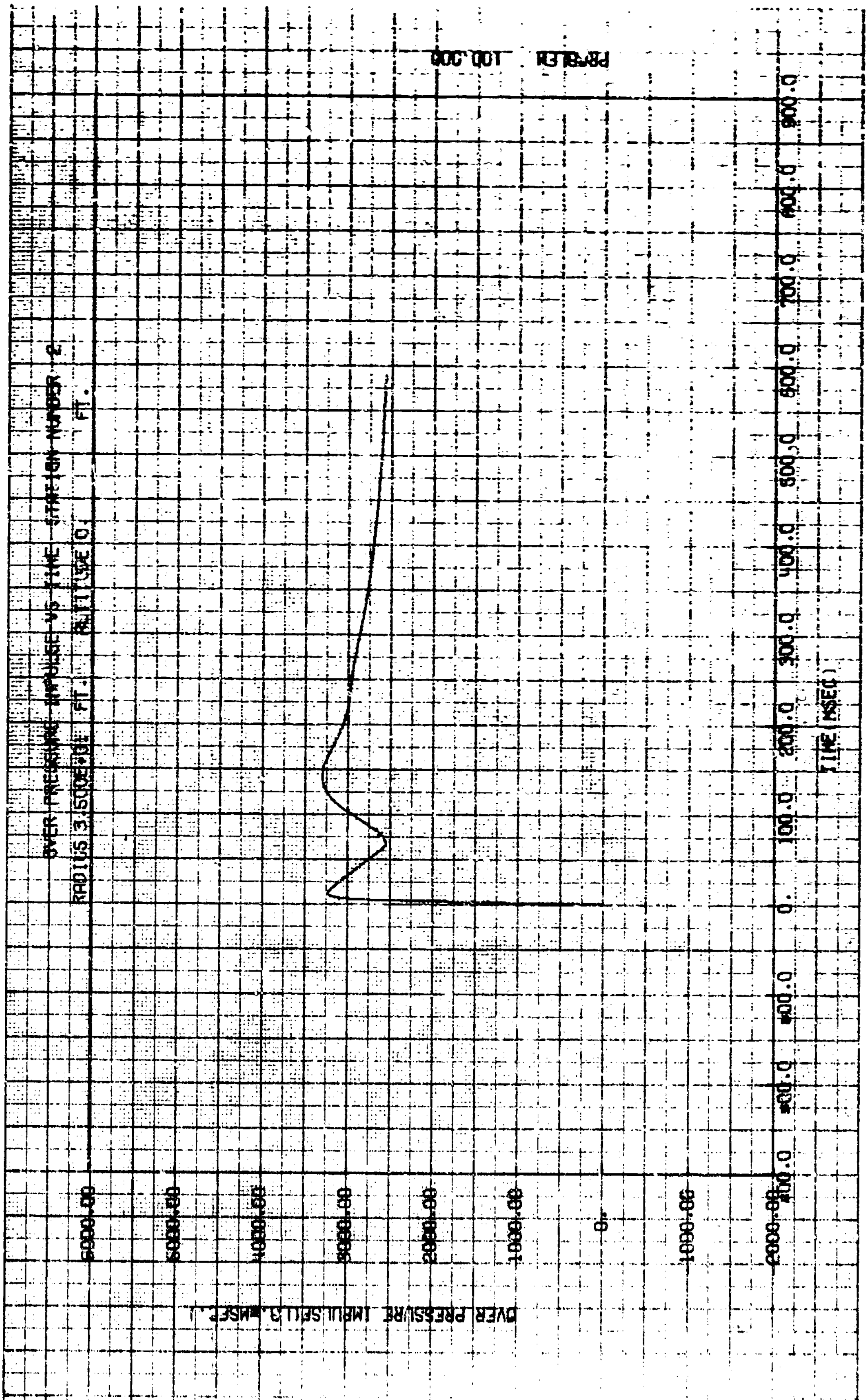

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 1
RADIUS 2.500E+03 FT. ALTITUDE 0. FT.
140000
120000
100000
80000
60000
40000
20000
0
-20000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
PROBLEM 100.000

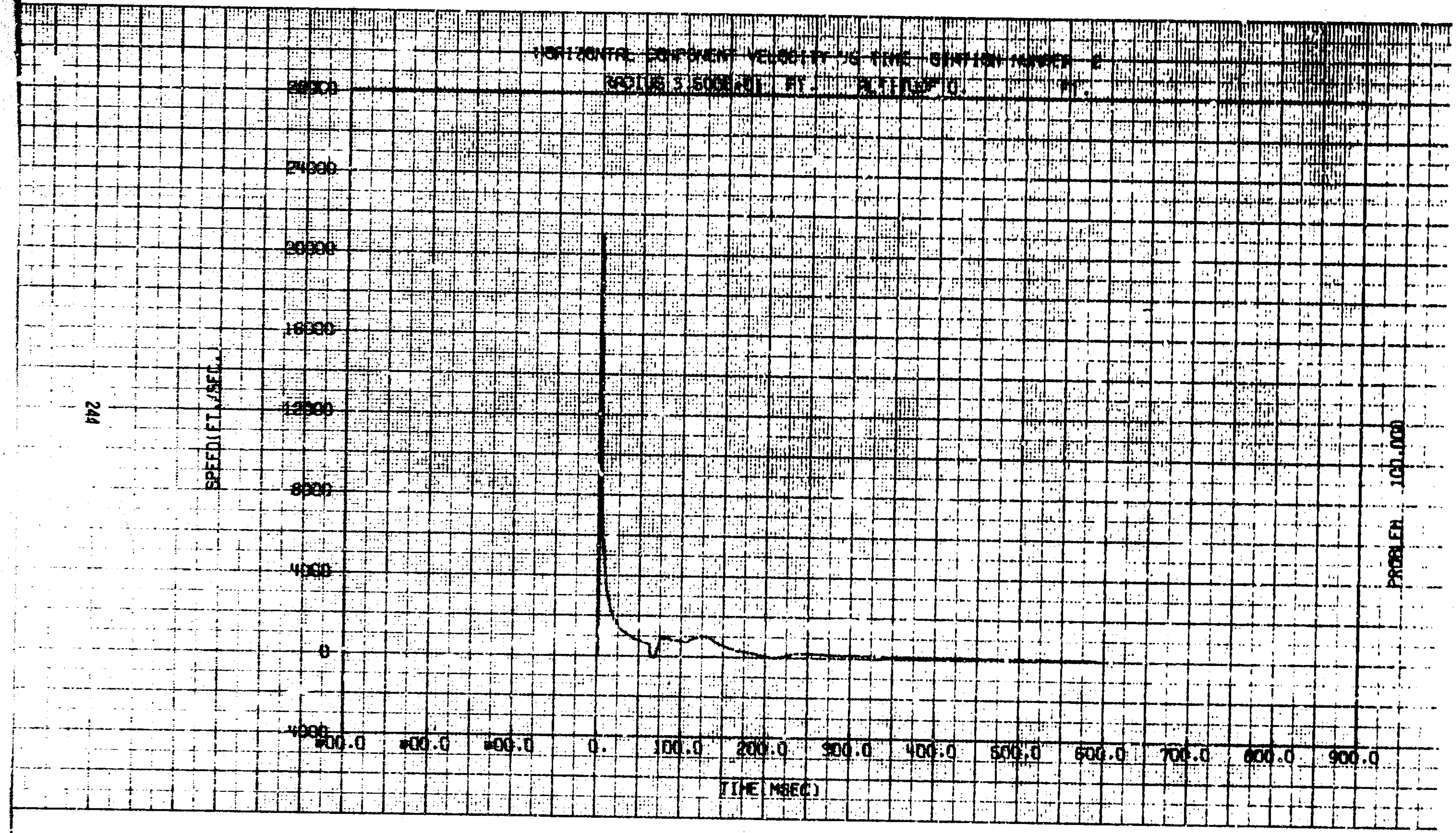

VERTICAL DYNAMIC PRESSURE VS TIME   STATION NUMBER 1
ALTITUDE 0.   FT.
50.00
40.00
20.00
10.00
0.
-10.00
-20.00
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM   100.000

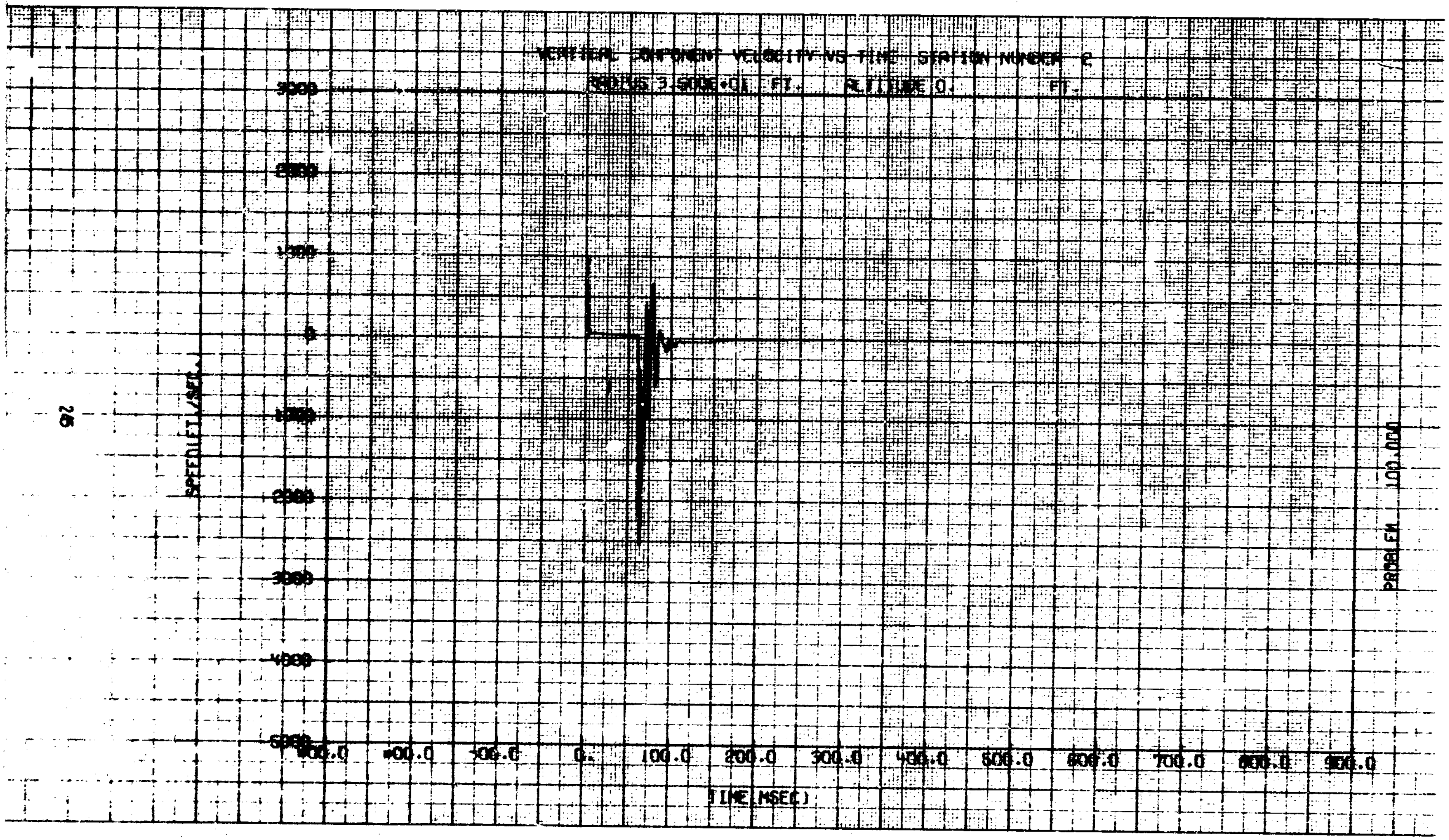


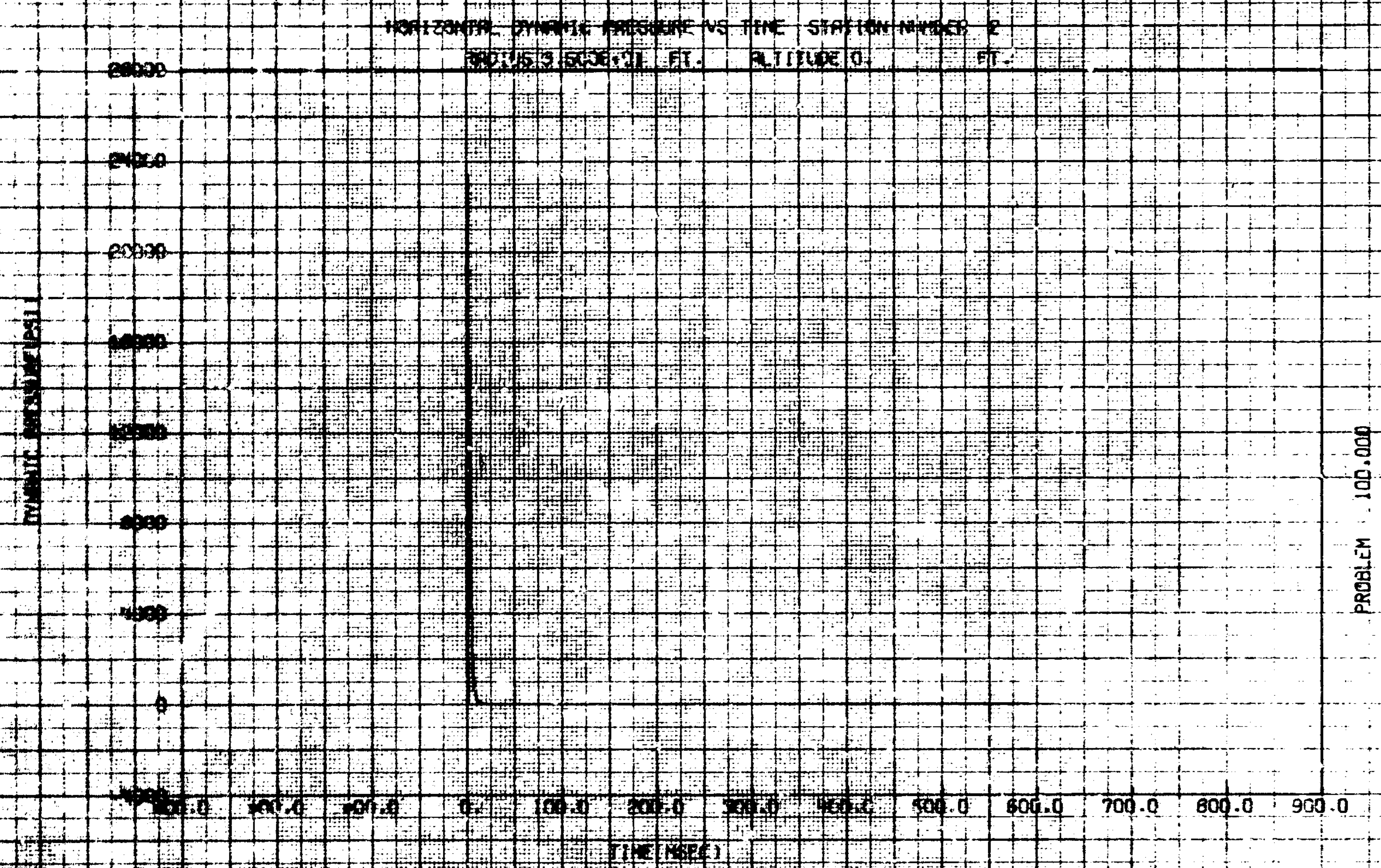
VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 1
RADIUS 2.600E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
30.00
20.00
10.00
0.
-10.00
-20.00
-30.00
-40.00
-50.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

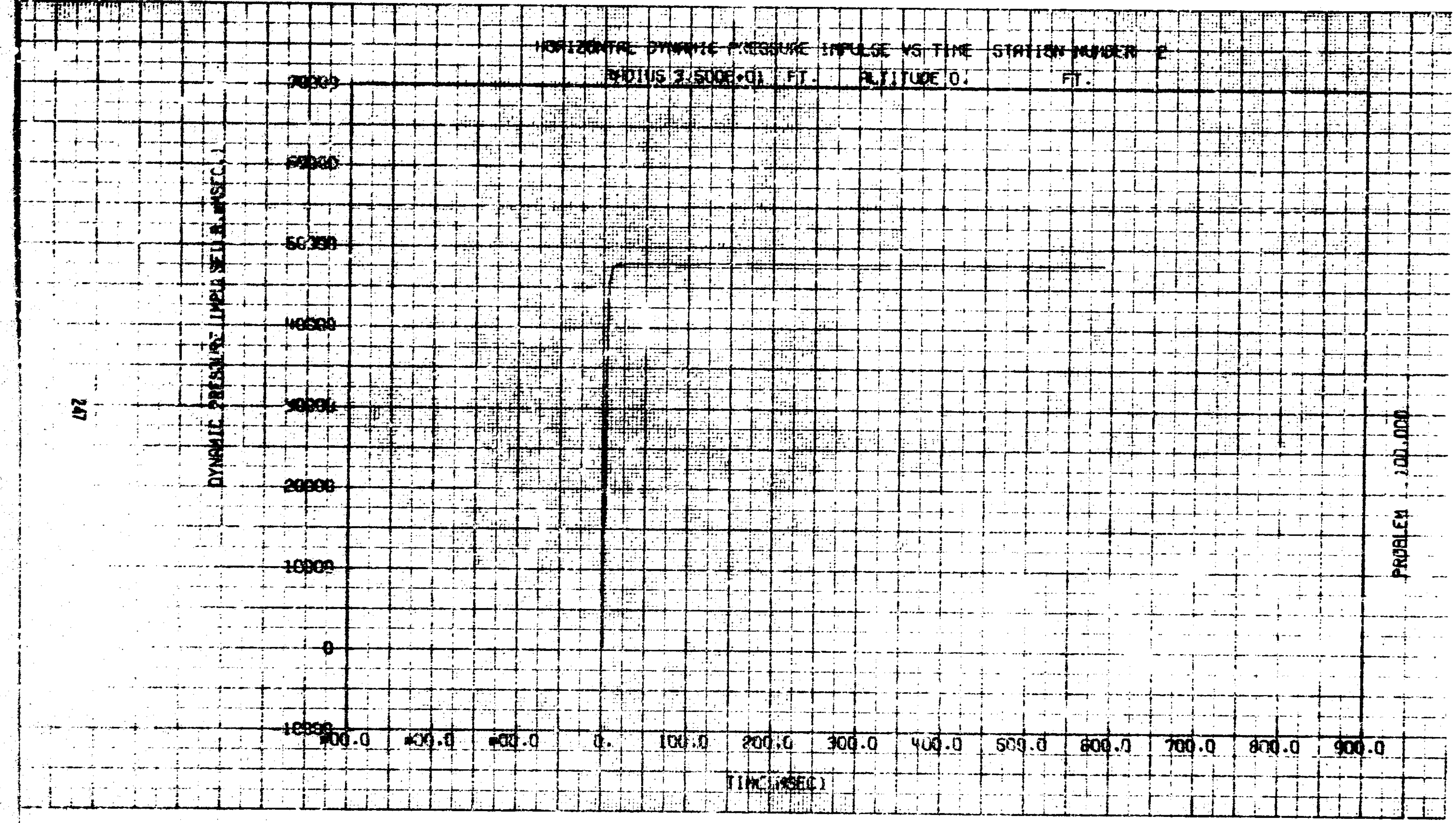

OVER PRESSURE VS TIME STATION NUMBER 2
OVER-PRESSURE(PSI)
0
1000
2000
TIME(MSEC)
0.
100.0
200.0
400.0
500.0
600.0
700.0
900.0
PROBLEM 100.000

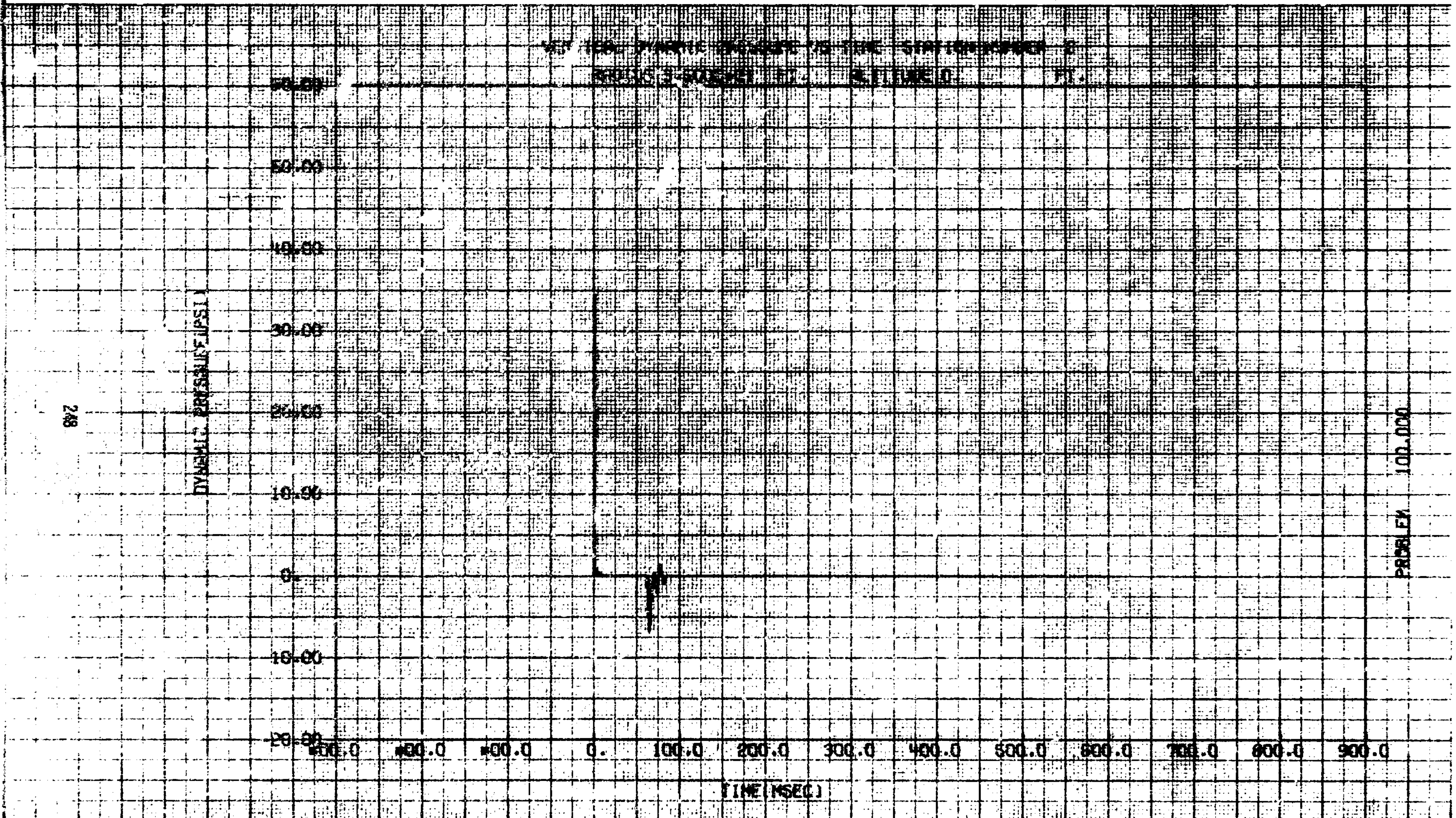

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 2
RADIUS 3.500E+01 FT. ALTITUDE 0. FT.
TIME (MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
-2000.00

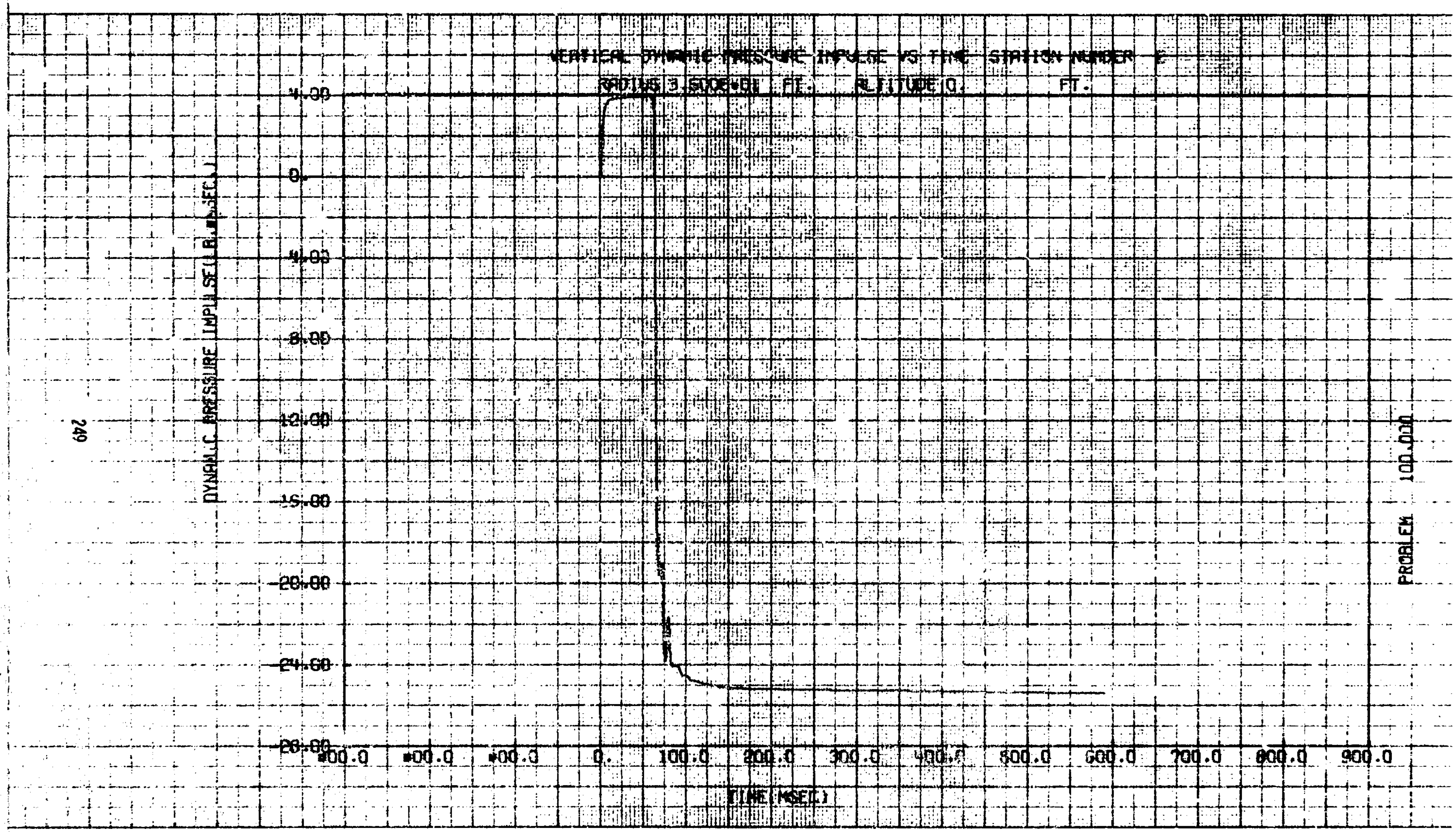

SPEED(FT./SEC.)
24000
20000
16000
12000
8000
4000
0
-4000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME MSEC)
PROBLEM 100.000

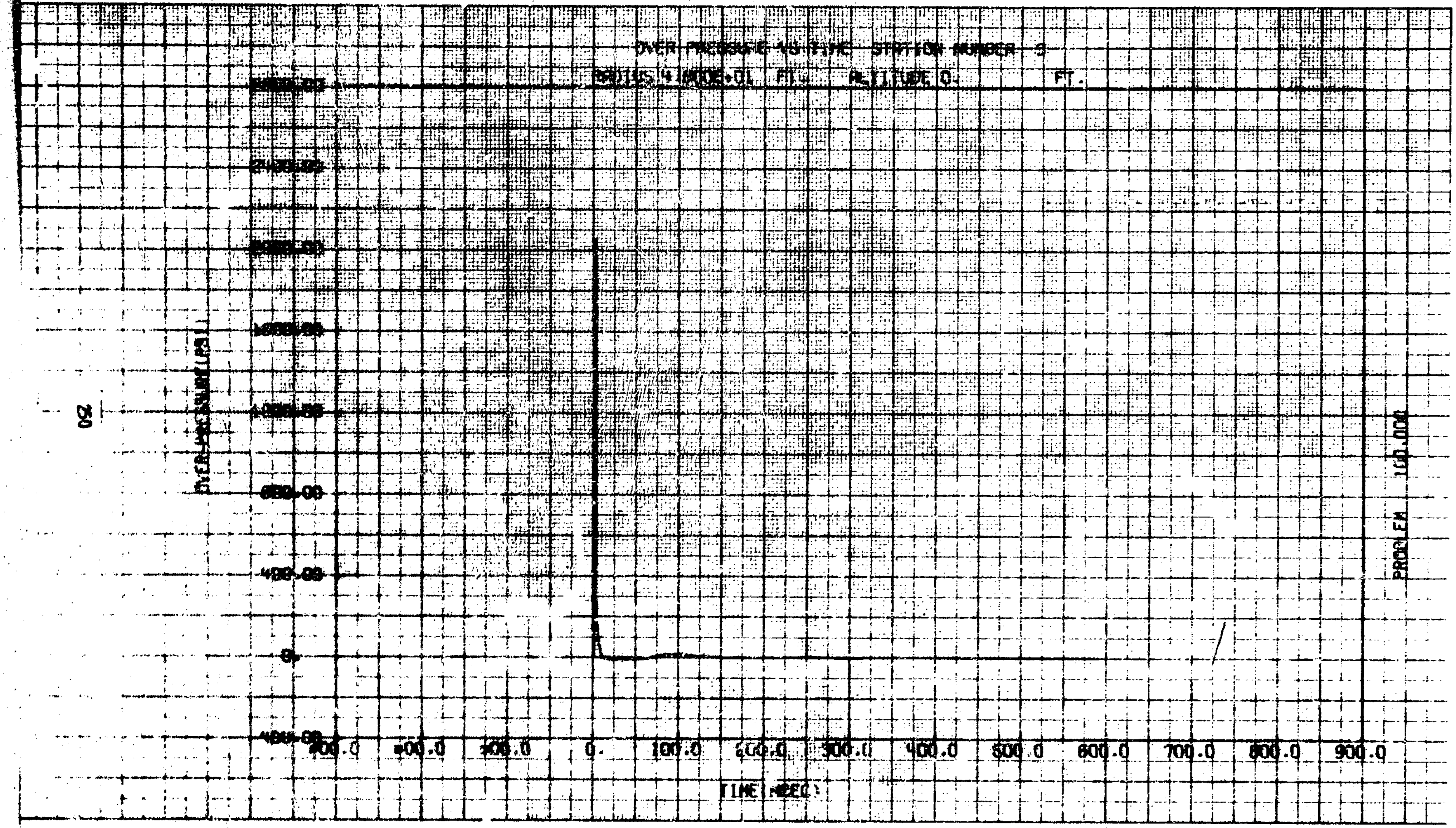

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 2
RADIUS 3.500E+01 FT. ALTITUDE 0. FT.
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
SPEED(FT/SEC.)
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100,000

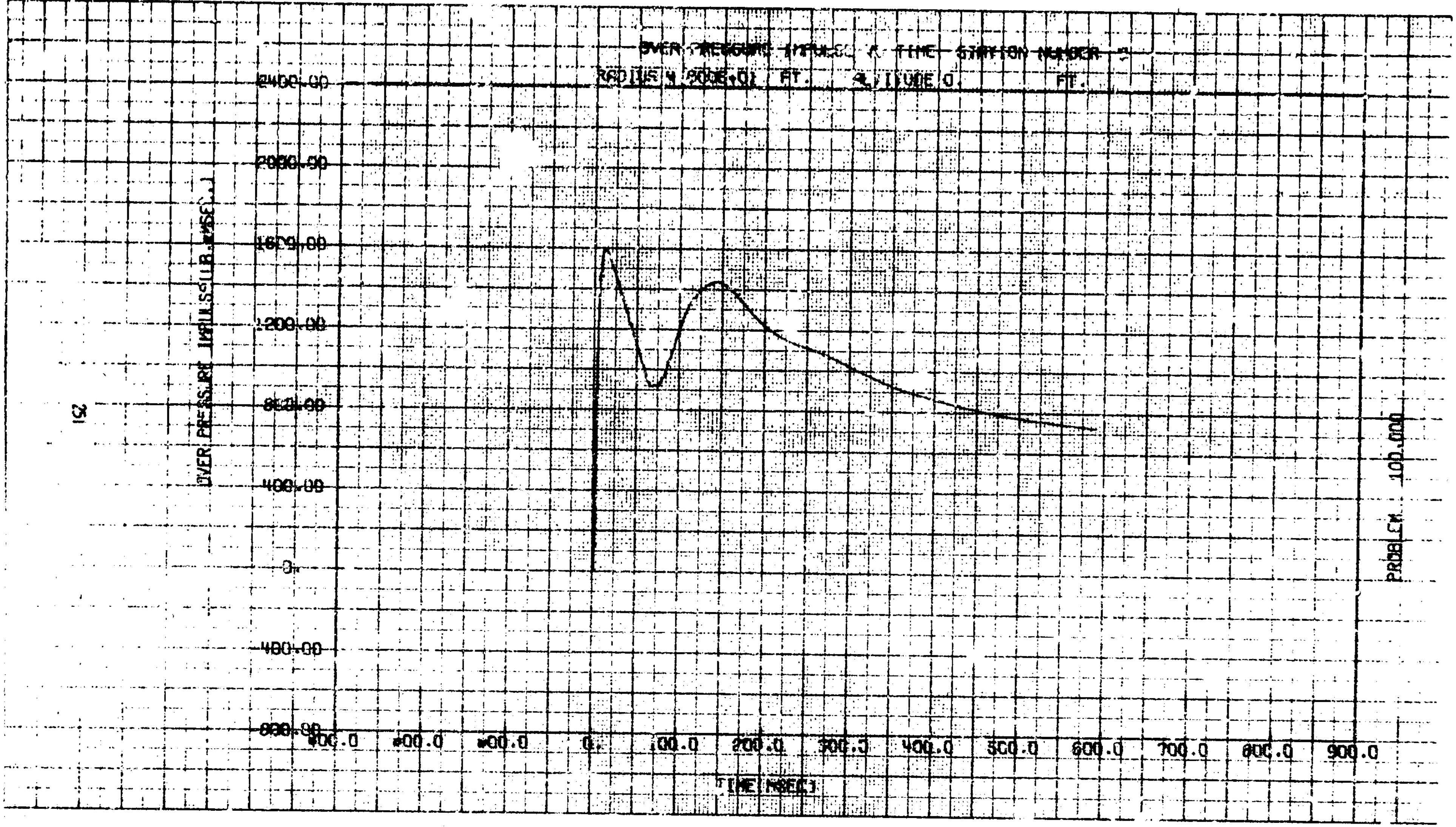

HORIZONTAL DYNAMIC PRESSURE VS TIME STATION NUMBER 2
ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

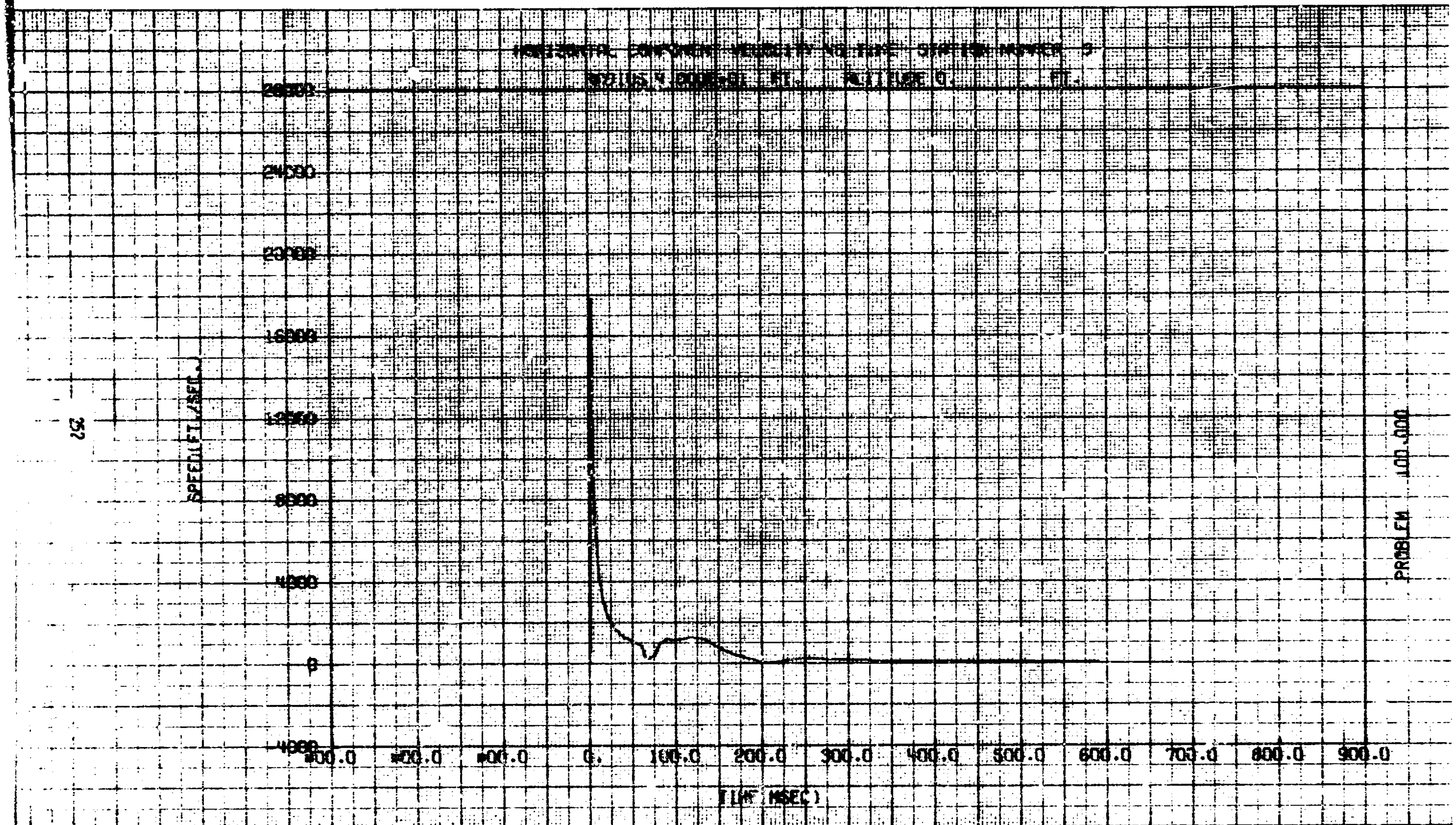

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 2
RADIUS 3.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
0
10000
20000
TIME(MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
PROBLEM 100.000

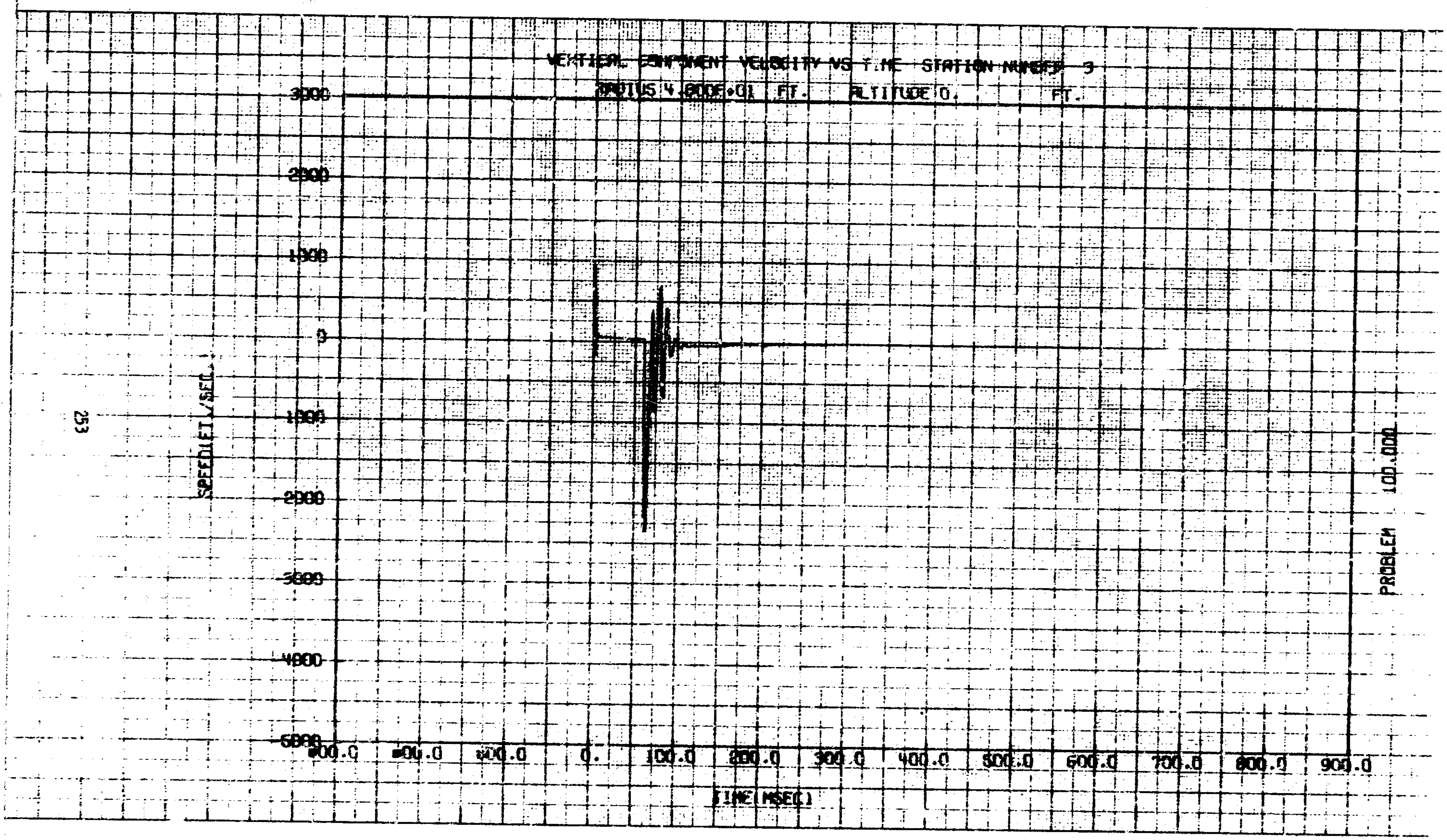

DYNAMIC PRESSURE(PSI)
60.00
50.00
40.00
30.00
20.00
10.00
0.
-10.00
-20.00
TIME(MSEC)
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
PROBLEM 100.000
FT.

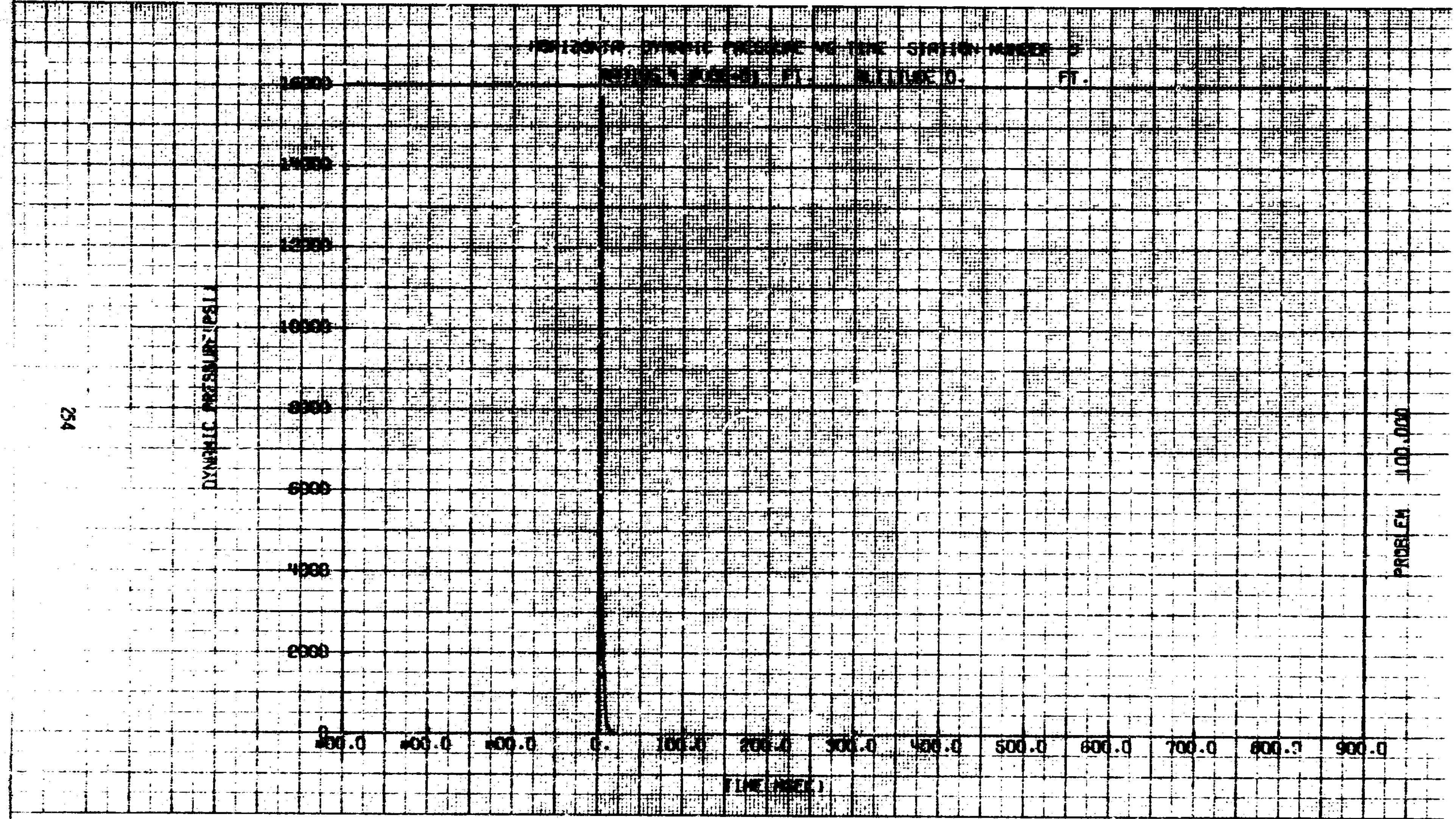

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER
RADIUS 3.500E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.MSEC.)
4.00
0.
-4.00
-8.00
-12.00
-16.00
-20.00
-24.00
-28.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

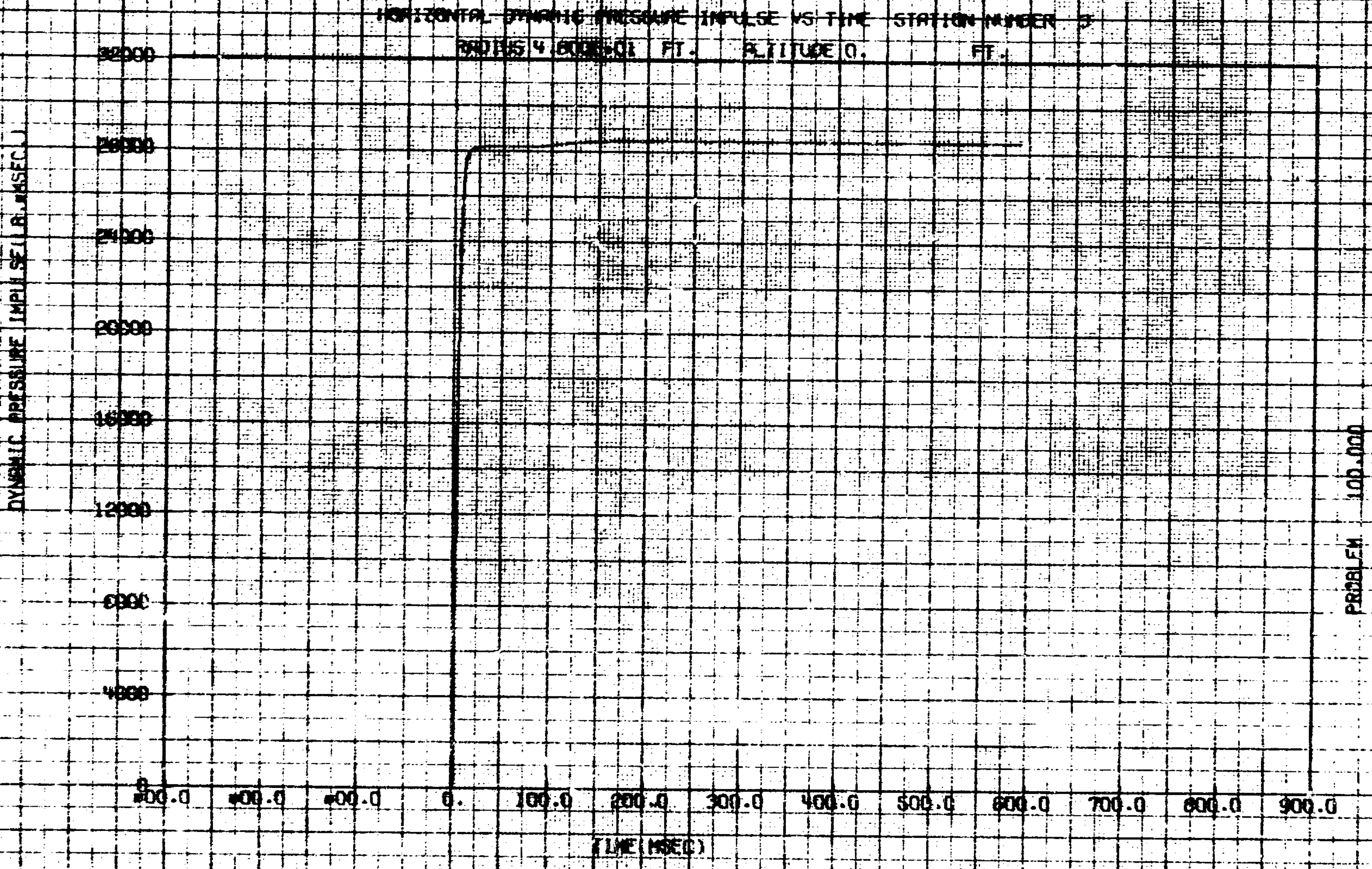

OVER PRESSURE VS TIME STATION NUMBER 3
RADIUS 4.1000E+01 FT. ALTITUDE 0. FT.
OVER PRESSURE (PSI)
TIME (MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
PROBLEM 100.000

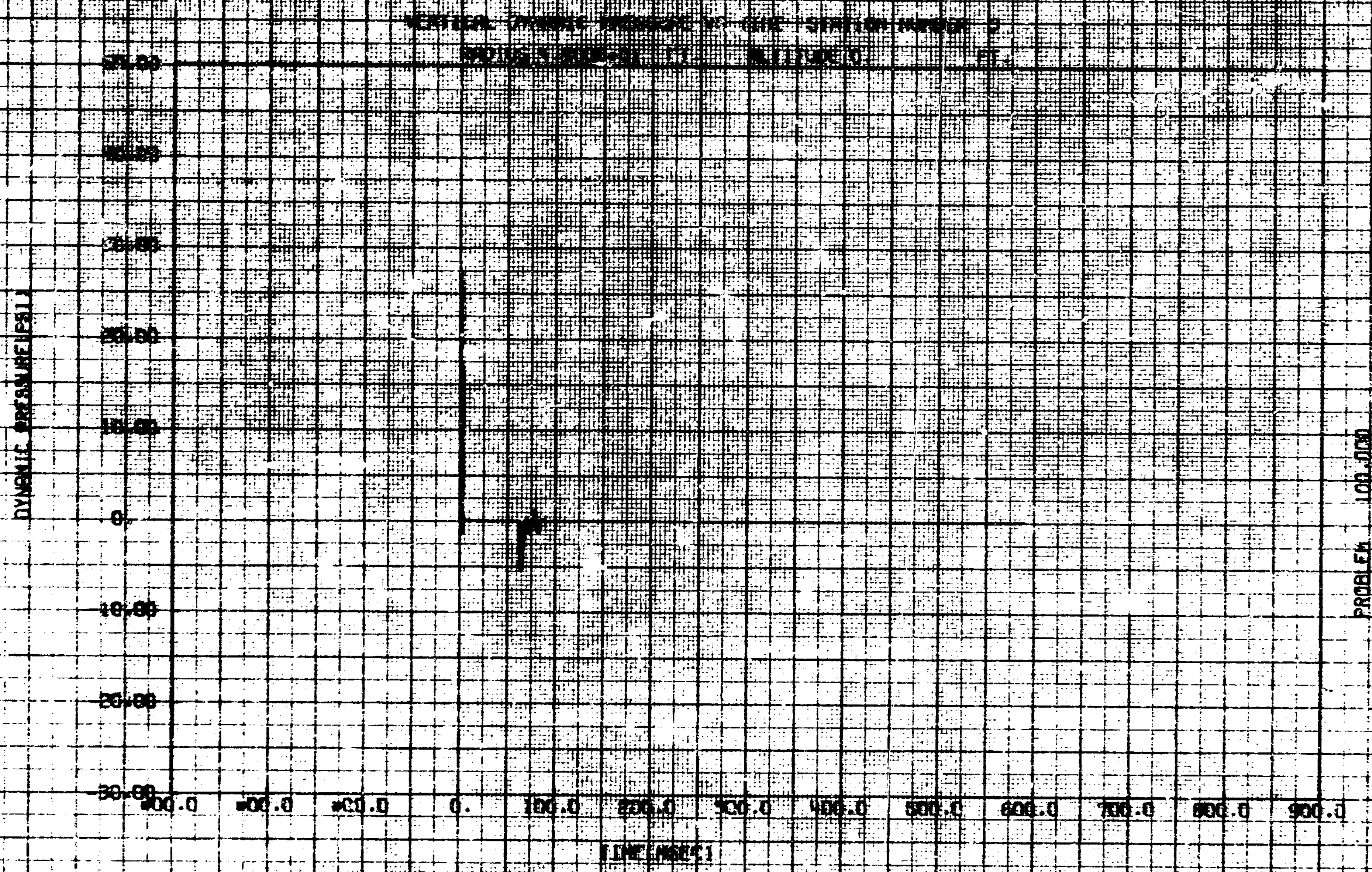

OVER PRESSURE IMPULSE & TIME STATION NUMBER
FT.
FT.
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-800.00
OVER PRESSURE IMPULSE(LB.MSEC.)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

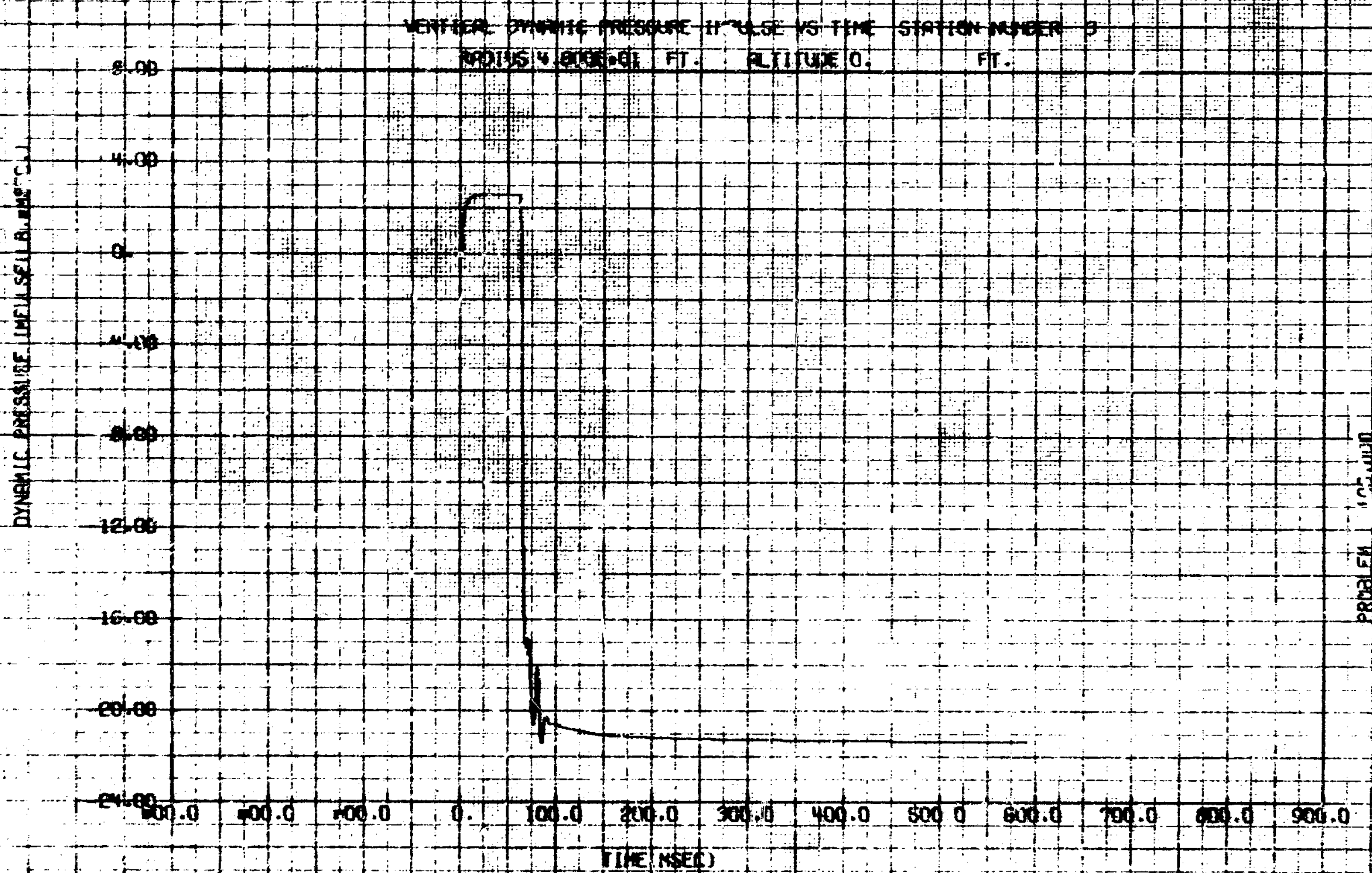

FT.
ALTITUDE 0.
28000
24000
20000
16000
12000
8000
4000
0
-4000
SPEED(FT./SEC.)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

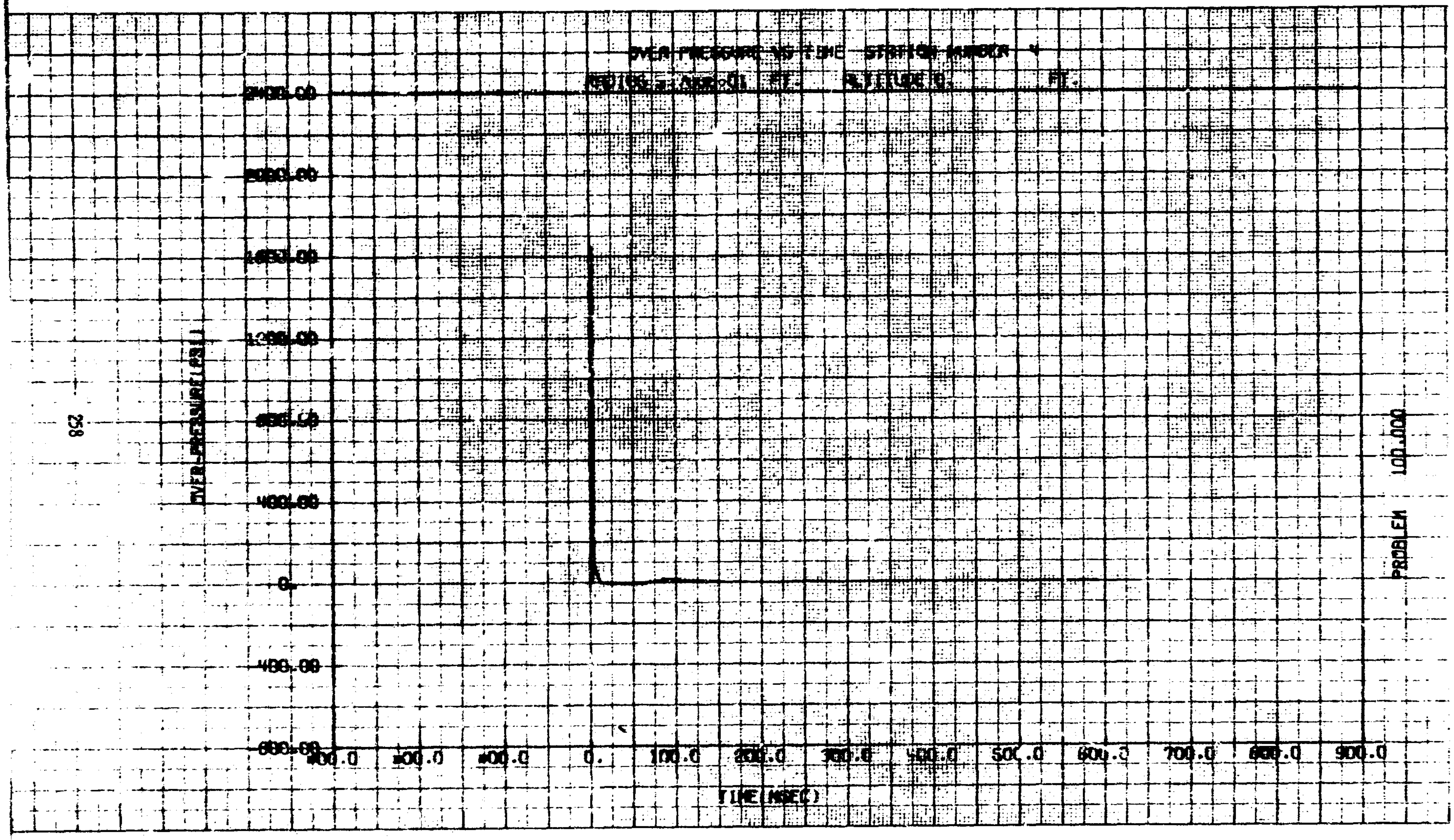

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 3
RADIUS 4.000E+01 FT. ALTITUDE 0. FT.
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
SPEED(FT/SEC.)
PROBLEM 100.000

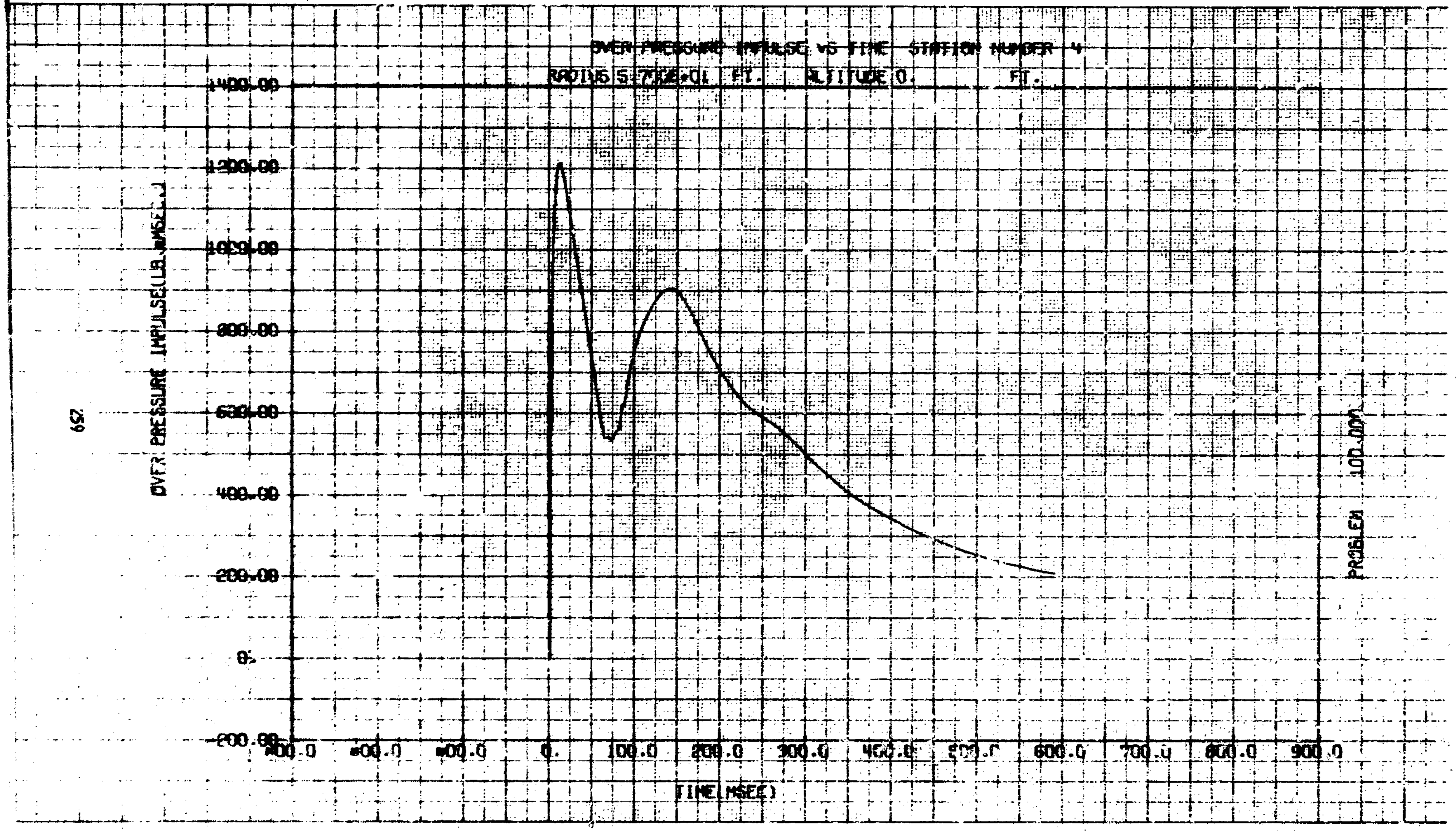

DYNAMIC PRESSURE(PSI)
16000
14000
12000
10000
8000
6000
4000
2000
0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

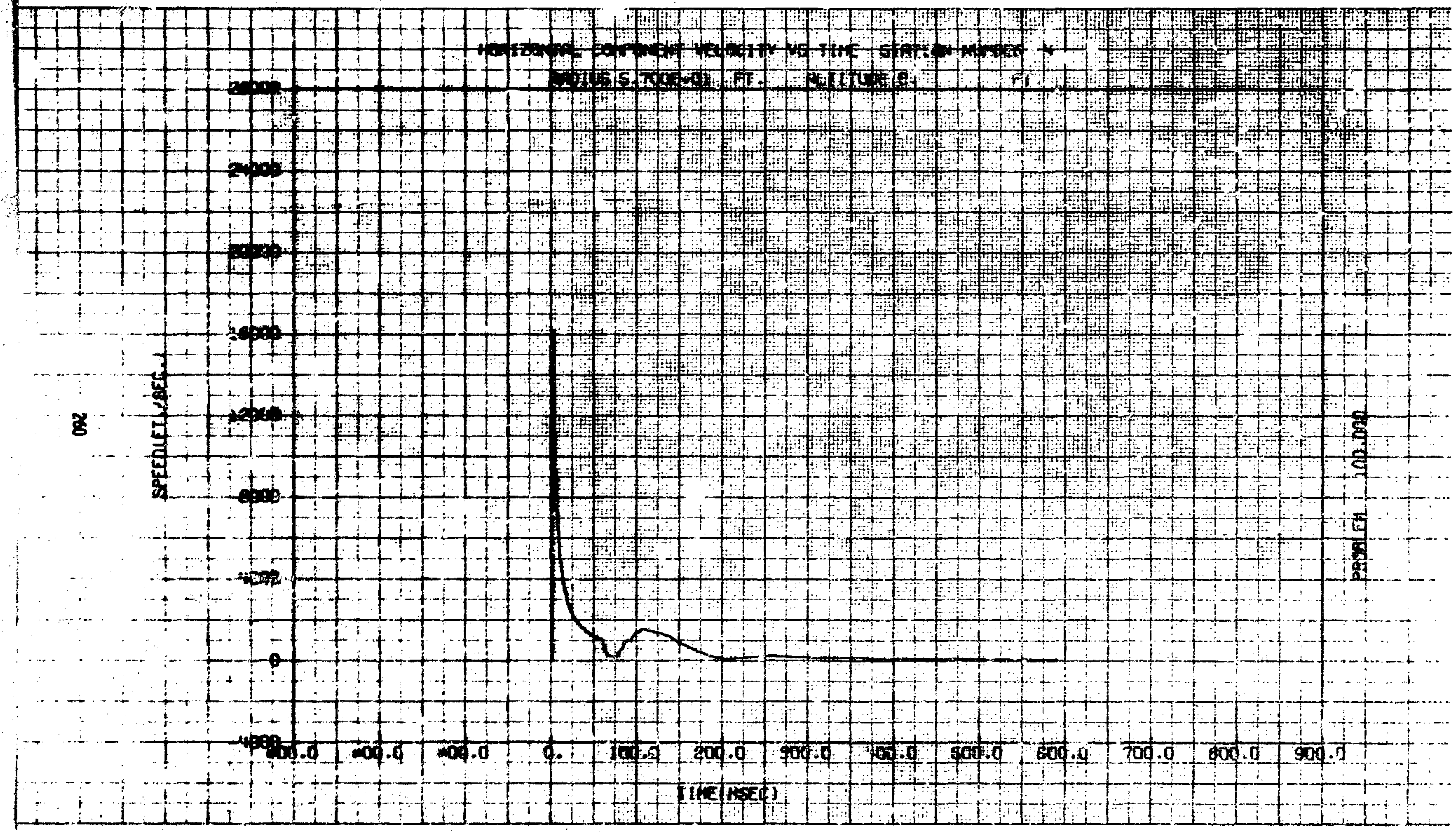

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 5
ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
32000
28000
24000
20000
16000
12000
8000
4000
0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

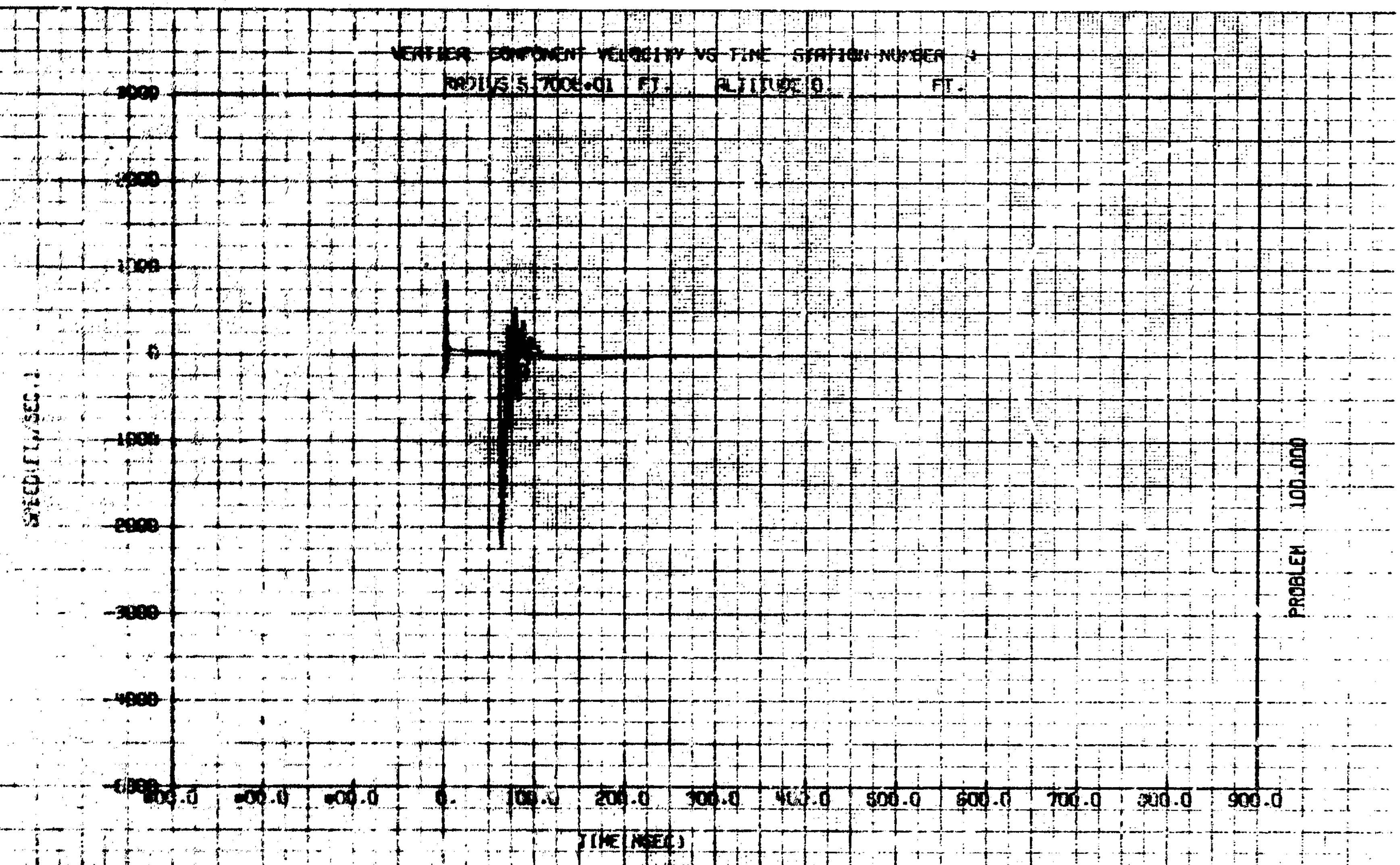

DYNAMIC PRESSURE(PSI)
0.
TIME(MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
PROBLEM 100.000


ALTITUDE 0.
FT.
8.00
4.00
0.
-12.00
-16.00
-20.00
-24.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM

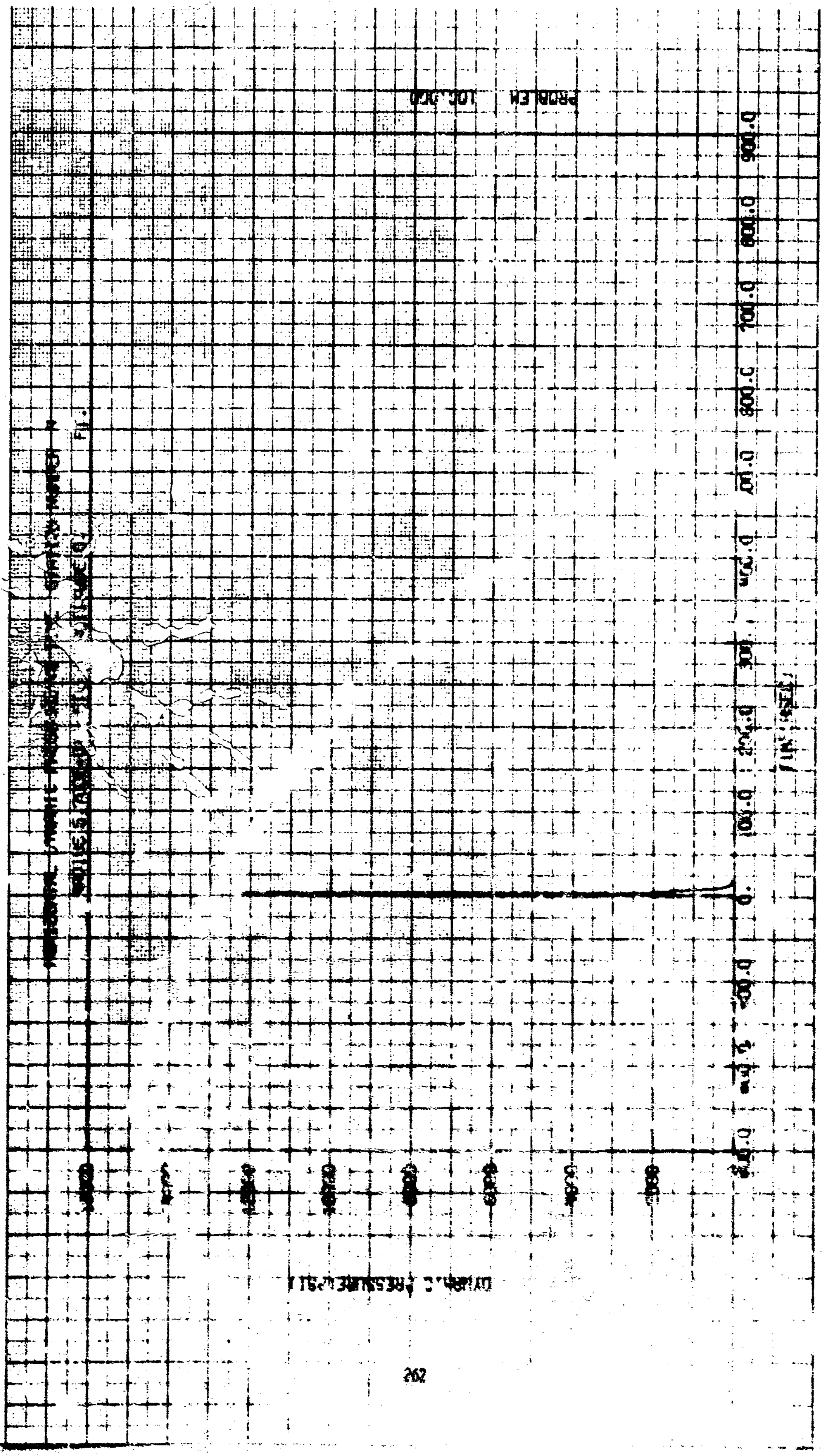

OVER-PRESSURE VS TIME STATION NUMBER 4
ALTITUDE 0. FT.
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-800.00
OVER-PRESSURE(PSI)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

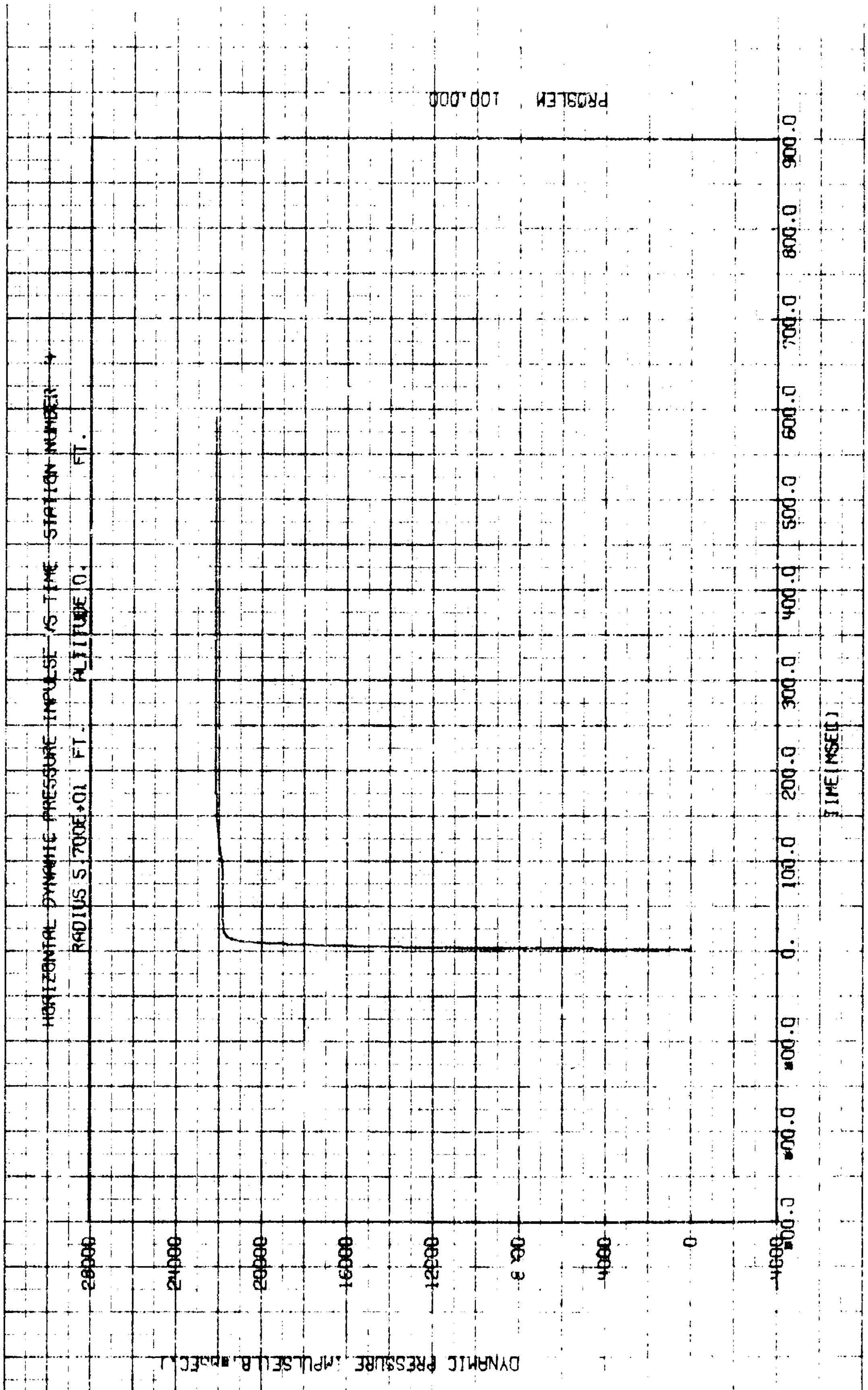

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 4
ALTITUDE 0. FT.
OVER PRESSURE IMPULSE(LB.MSEC.)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
100.0
200.0
300.0
600.0
900.0
TIME(MSEC)
PROBLEM

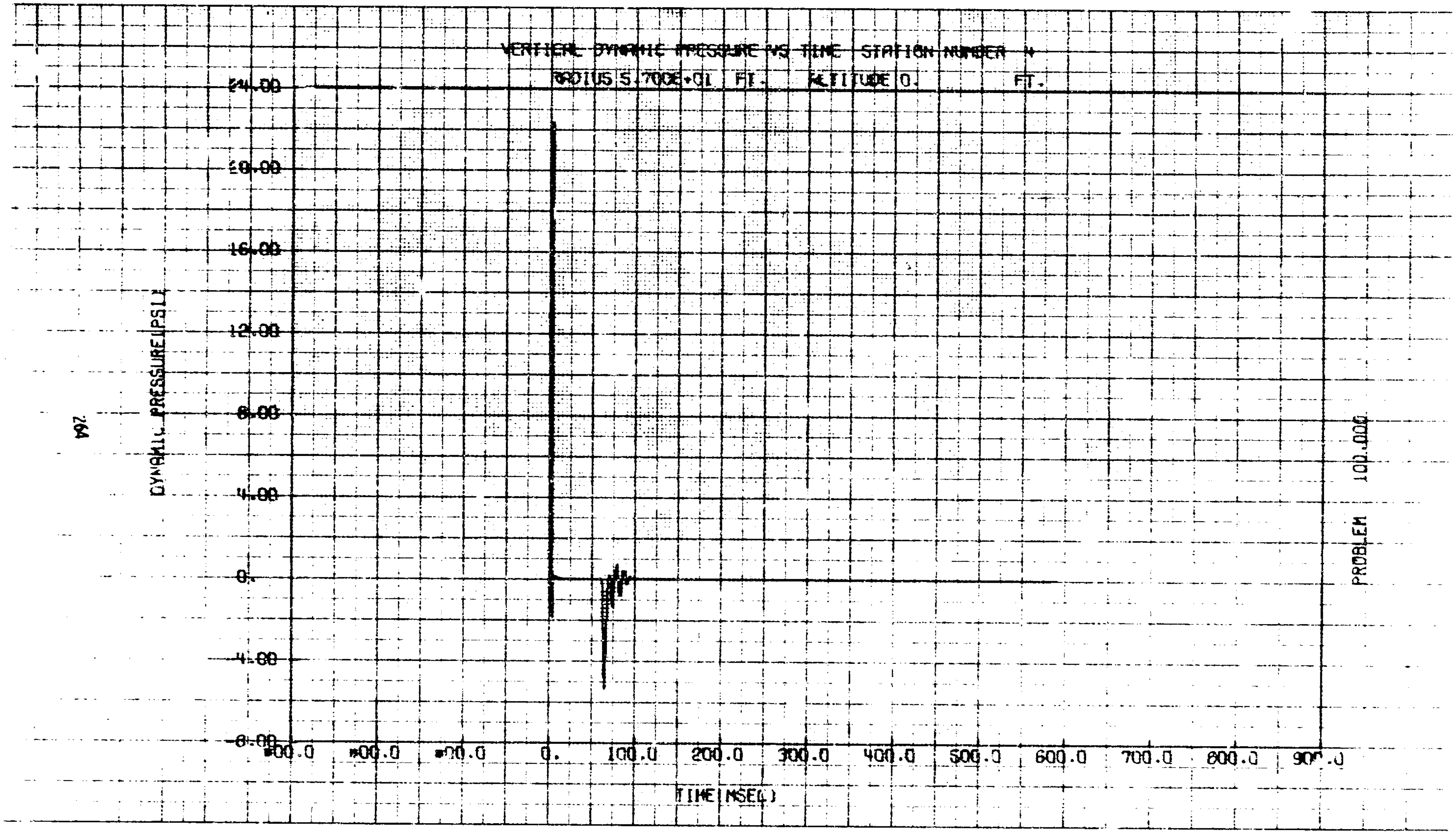

HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 4
RADIUS 5.700E+01 FT. ALTITUDE 0. FT
SPEED(FT/SEC.)
0
0.
100.0
200.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000



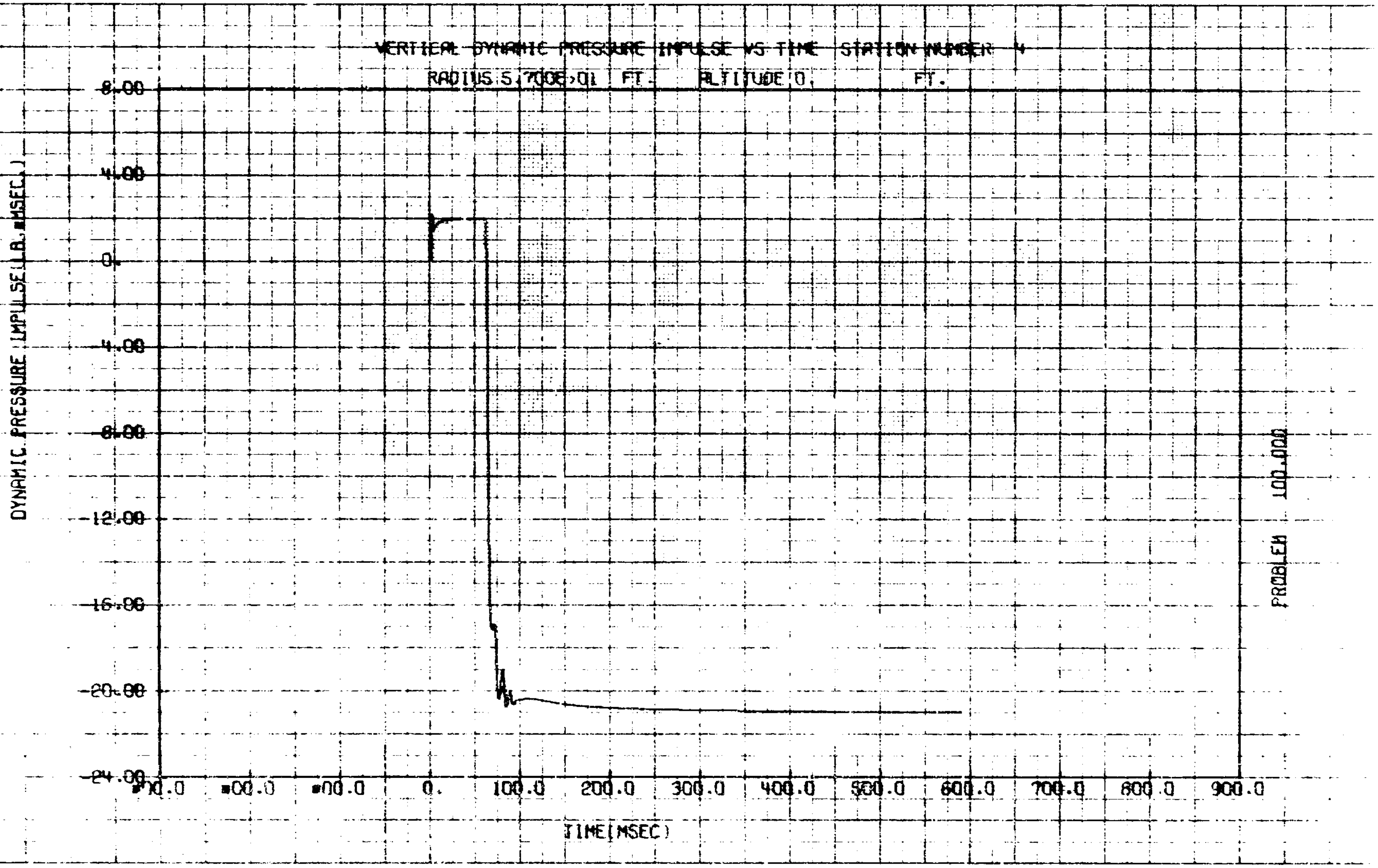
VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER
RADIUS 5.700E+01 FT. ALTITUDE 0. FT.
3000
2000
1000
0
-1000
-2000
-3000
-4000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
SPEED(FT/SEC)
PROBLEM 100.000

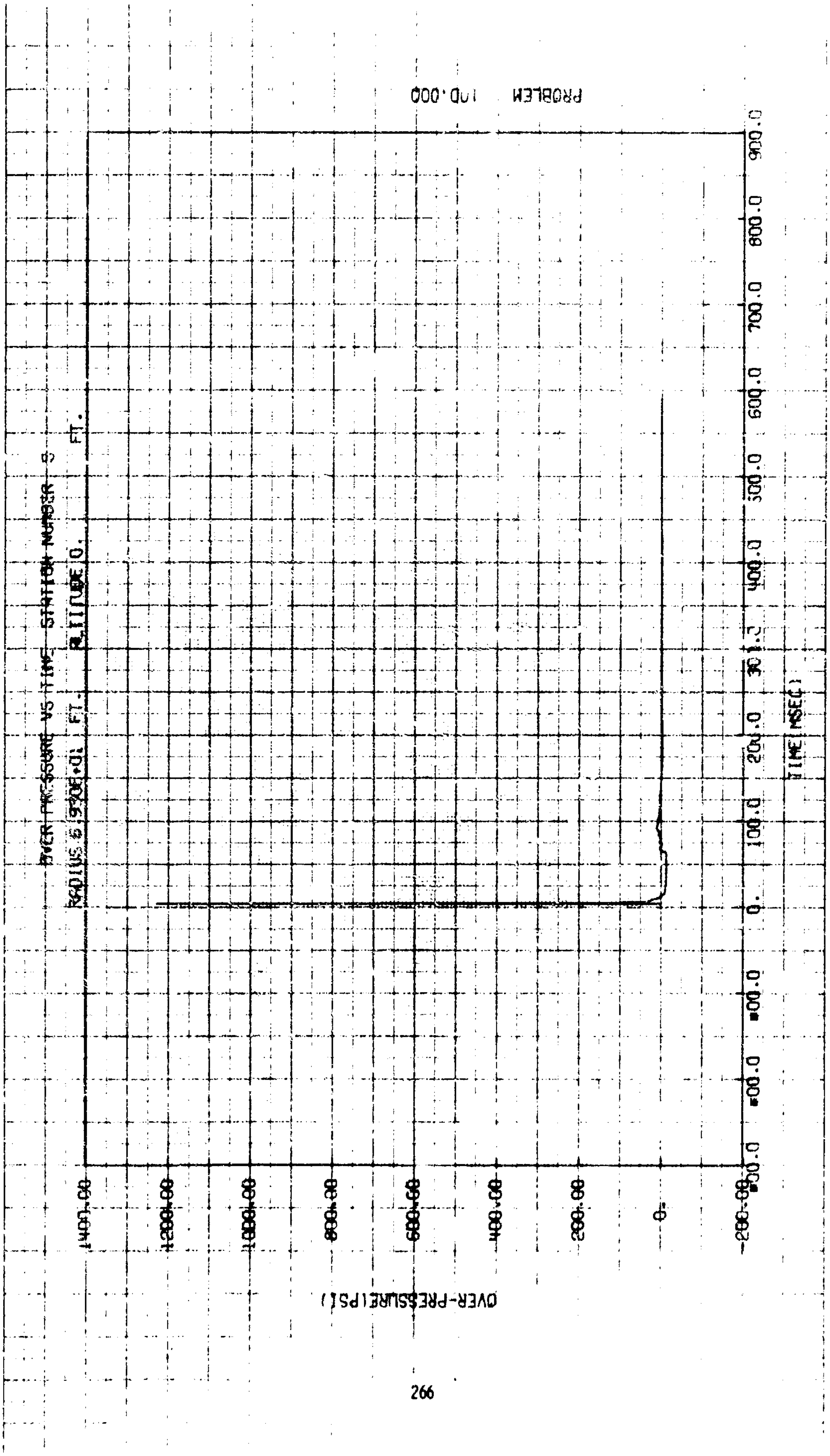

PROBLEM
0.
100.0
200.0
400.0
500.0
600.0
700.0
800.0
900.0

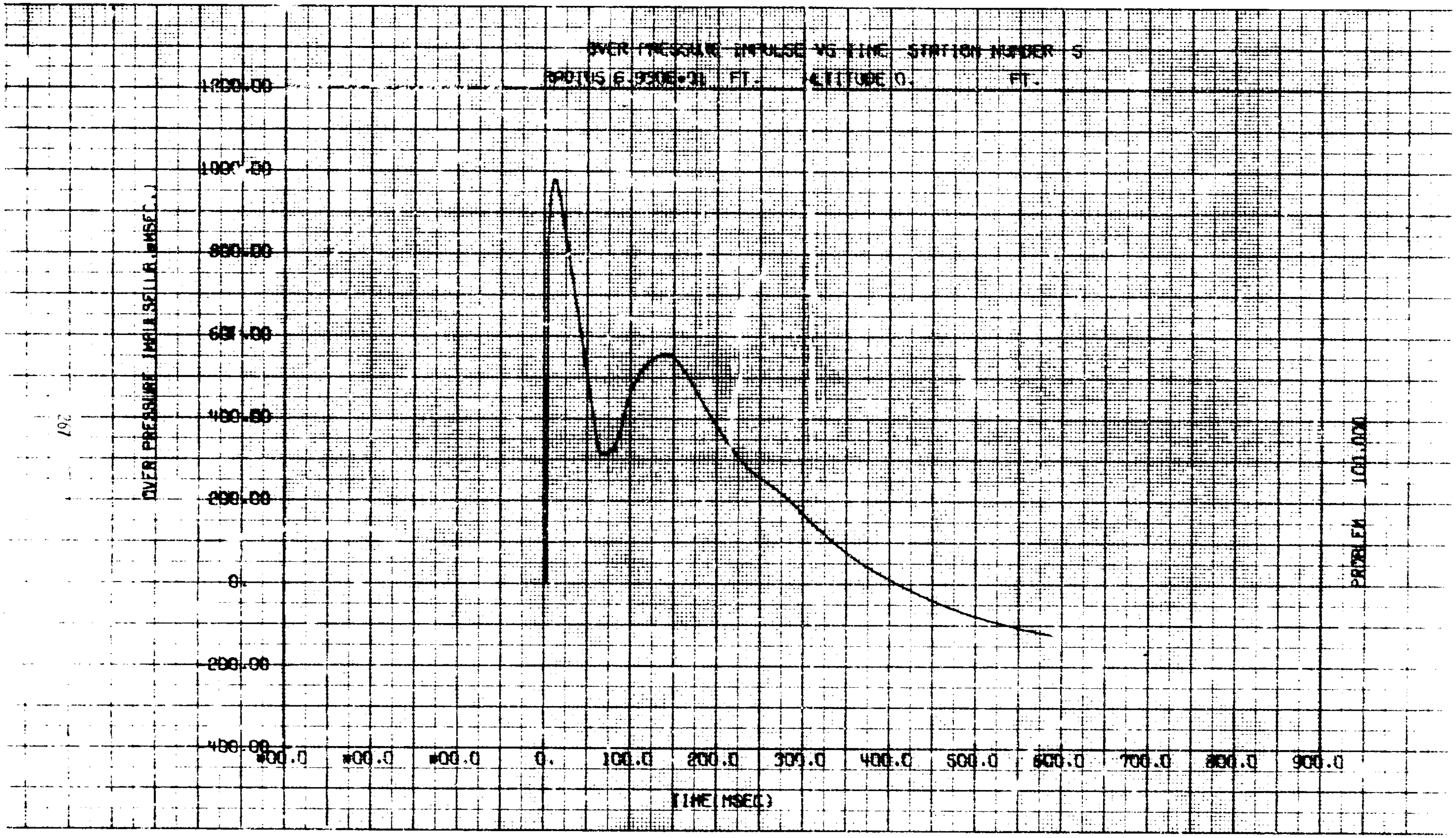

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 4
RADIUS 5.700E+01 FT. ALTITUDE 0. FT.
PROBLEM 100.000
DYNAMIC PRESSURE IMPULSE(LB-MSEC.)
TIME(MSEC)
28000
24000
20000
16000
12000
8000
4000
0
-4000
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0

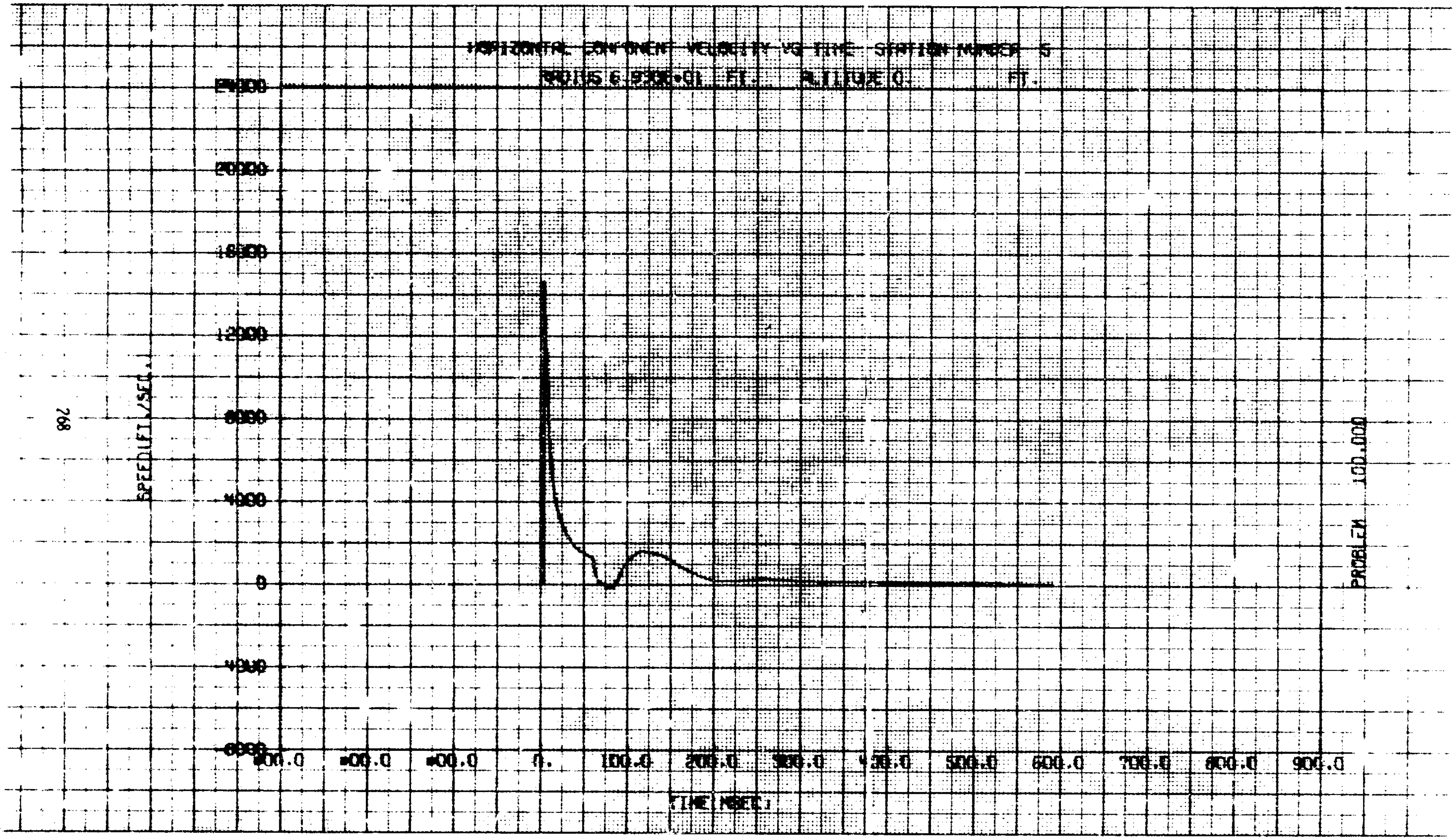


VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 4
RADIUS 5.700E+01 FT. ALTITUDE 0. FT.
24.00
20.00
16.00
12.00
8.00
4.00
0.
-4.00
-8.00
DYNAMIC PRESSURE(PSI)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
TIME(MSEC)
PROBLEM 100.000

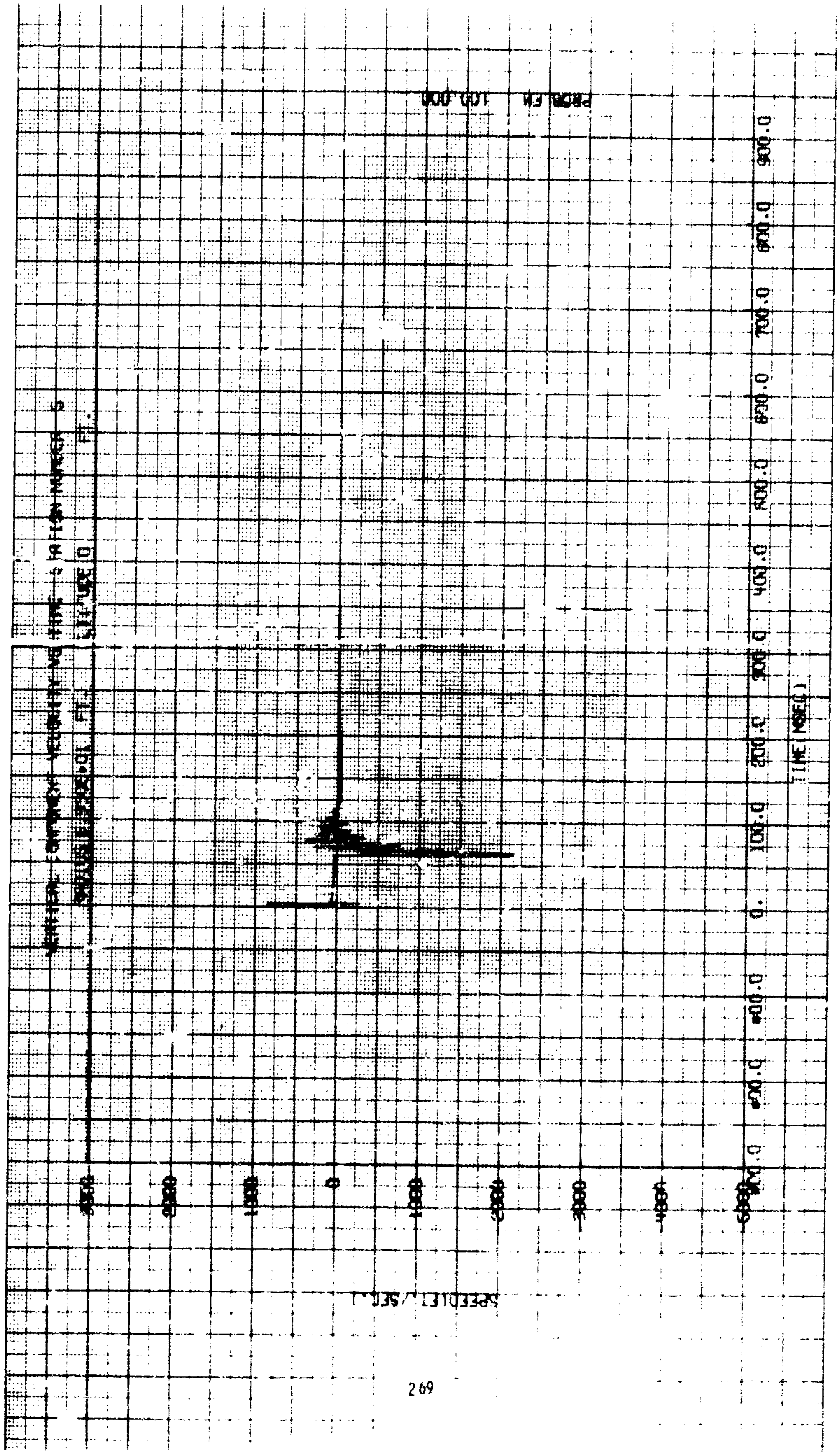

VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 4
RADIUS 5.700E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE(LB.*MSEC.)
8.00
4.00
0.
-4.00
-8.00
-12.00
-16.00
-20.00
-24.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

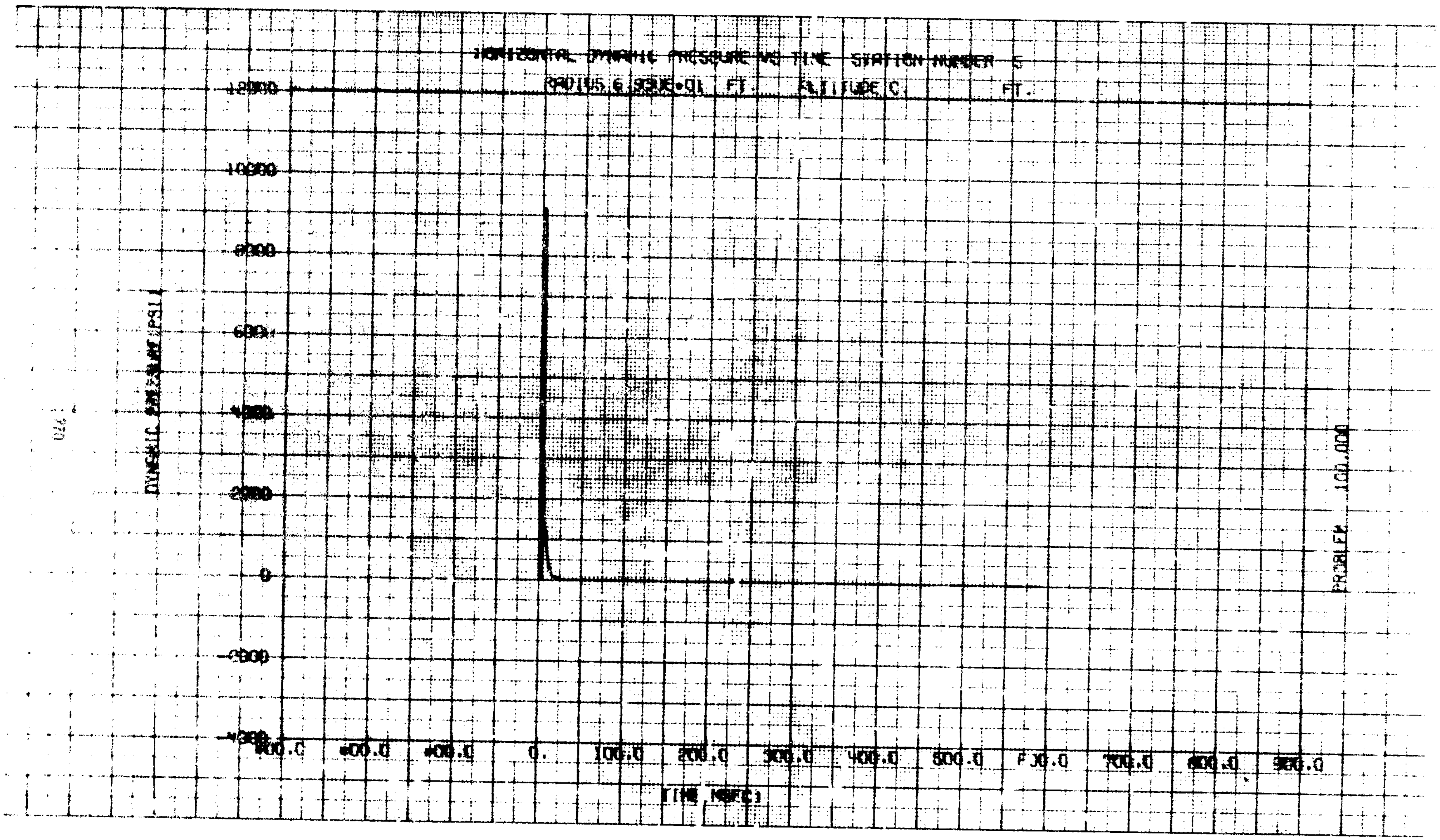

PROBLEM 100.000
OVER-PRESSURE VS TIME STATION NUMBER 5
RADIUS 6.930E+01 FT. ALTITUDE 0. FT.
TIME(MSEC)
OVER-PRESSURE(PSI)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
0.
100.0
200.0
400.0
500.0
600.0
700.0
800.0
900.0


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 5
RADIUS 6.930E+01 FT. ALTITUDE 0. FT.
1200.00
1000.00
800.00
600.00
400.00
200.00
0.
-200.00
-400.00
OVER PRESSURE IMPULSE(LB.*MSEC.)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

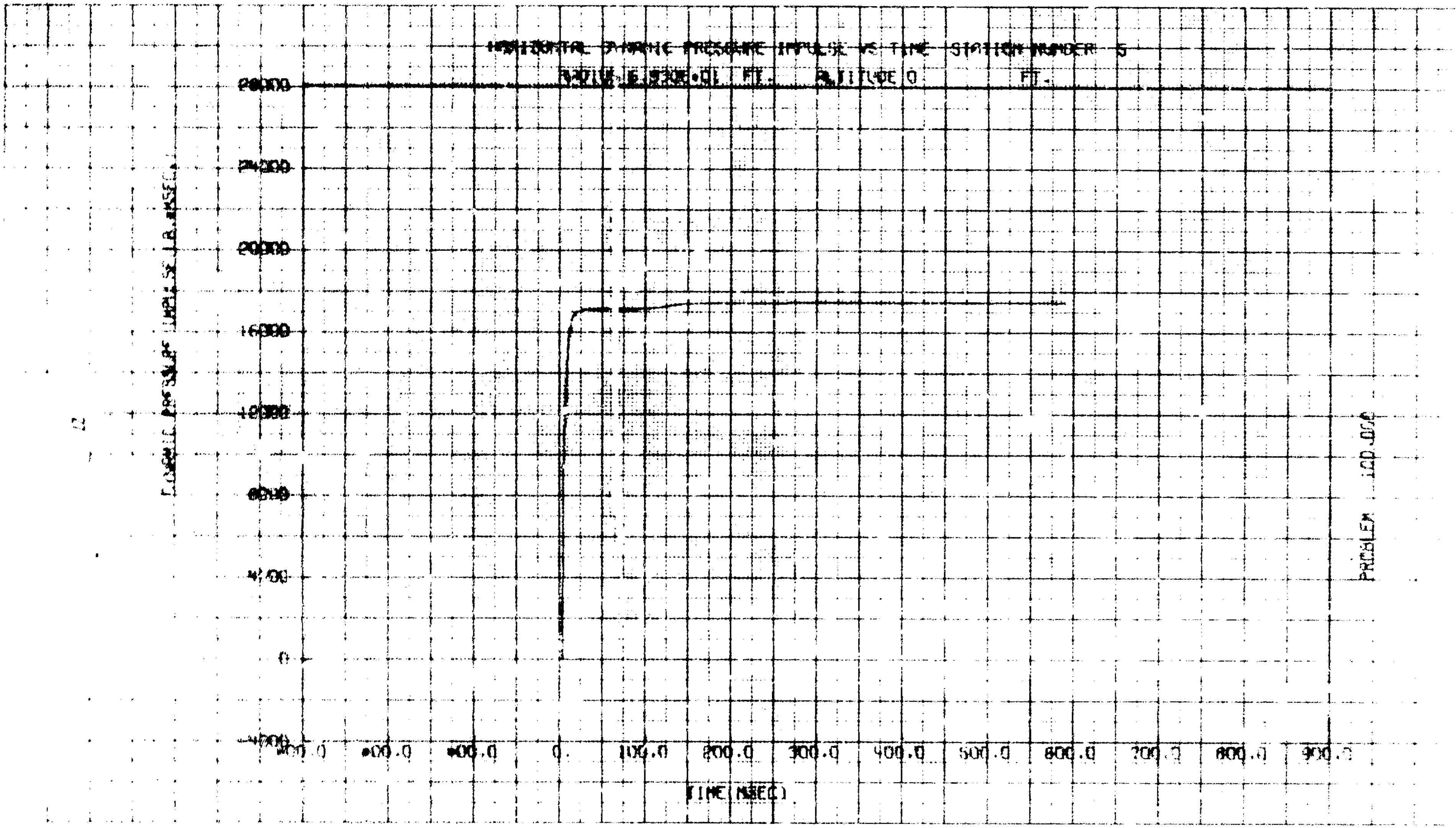


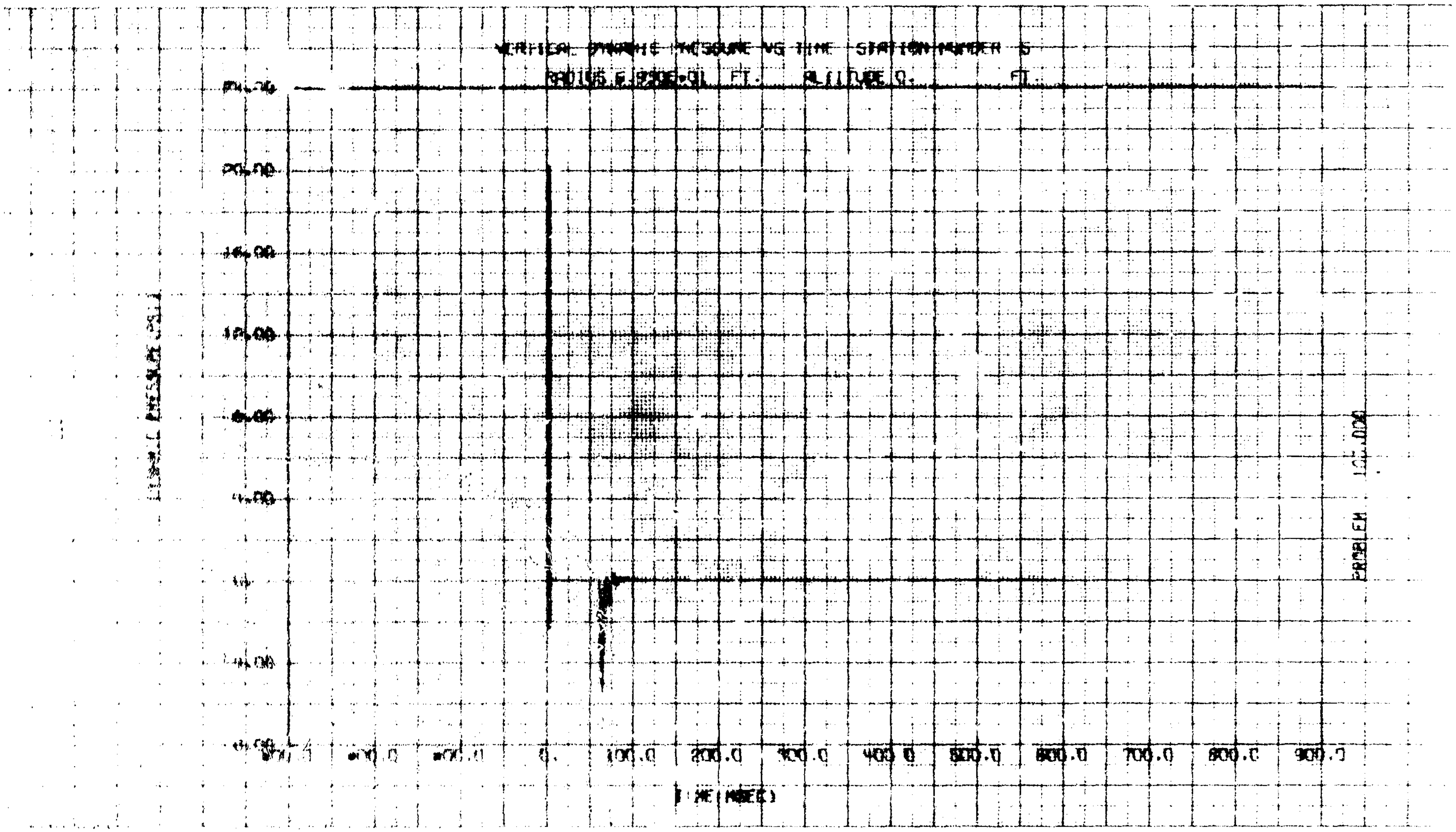
HORIZONTAL COMPONENT VELOCITY VS TIME STATION NUMBER 5
RADIUS 6.930E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
20000
16000
12000
8000
4000
0
-4000
-8000
100.0
200.0
300.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

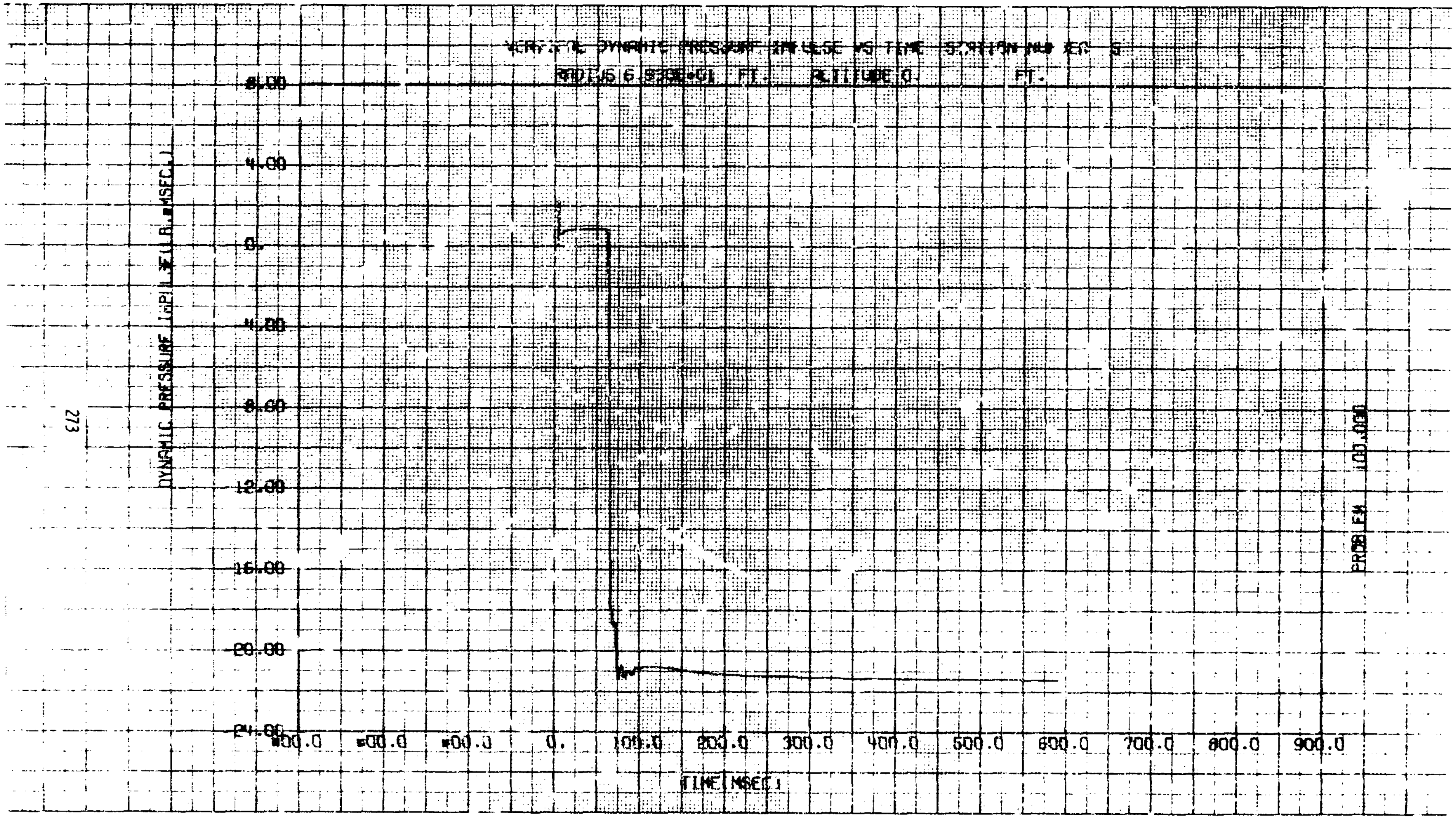

VERTICAL COMPONENT VELOCITY VS TIME, STATION NUMBER 5
PROBLEM 100.000
TIME (MSEC)
SPEED(FT./SEC.)

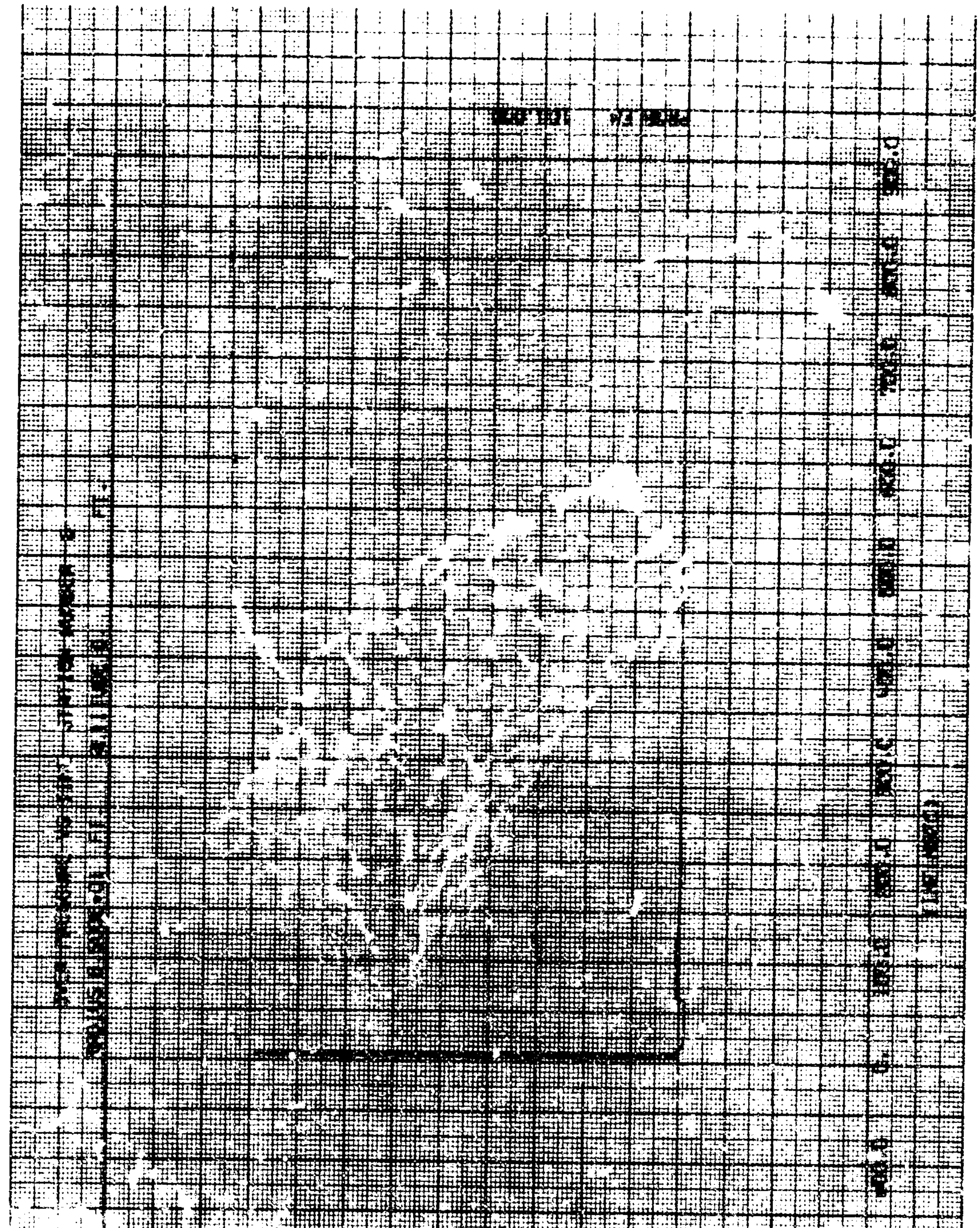

HORIZONTAL DYNAMIC PRESSURE VS TIME   STATION NUMBER 5
RADIUS 6.950E+01 FT.   ALTITUDE 0. FT.
12000
10000
8000
6000
4000
2000
0
-2000
-4000
DYNAMIC PRESSURE(PSI)
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

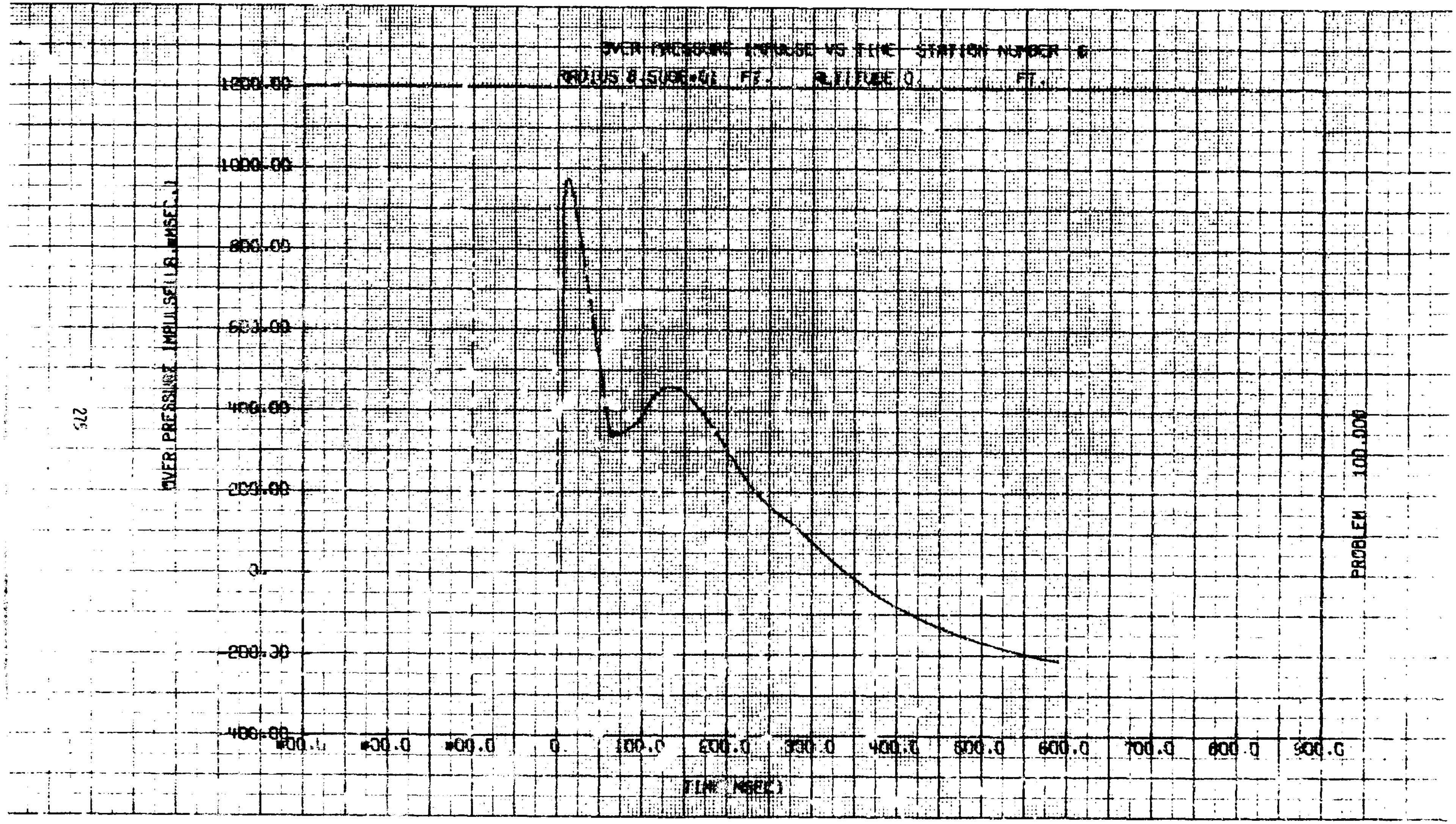
270

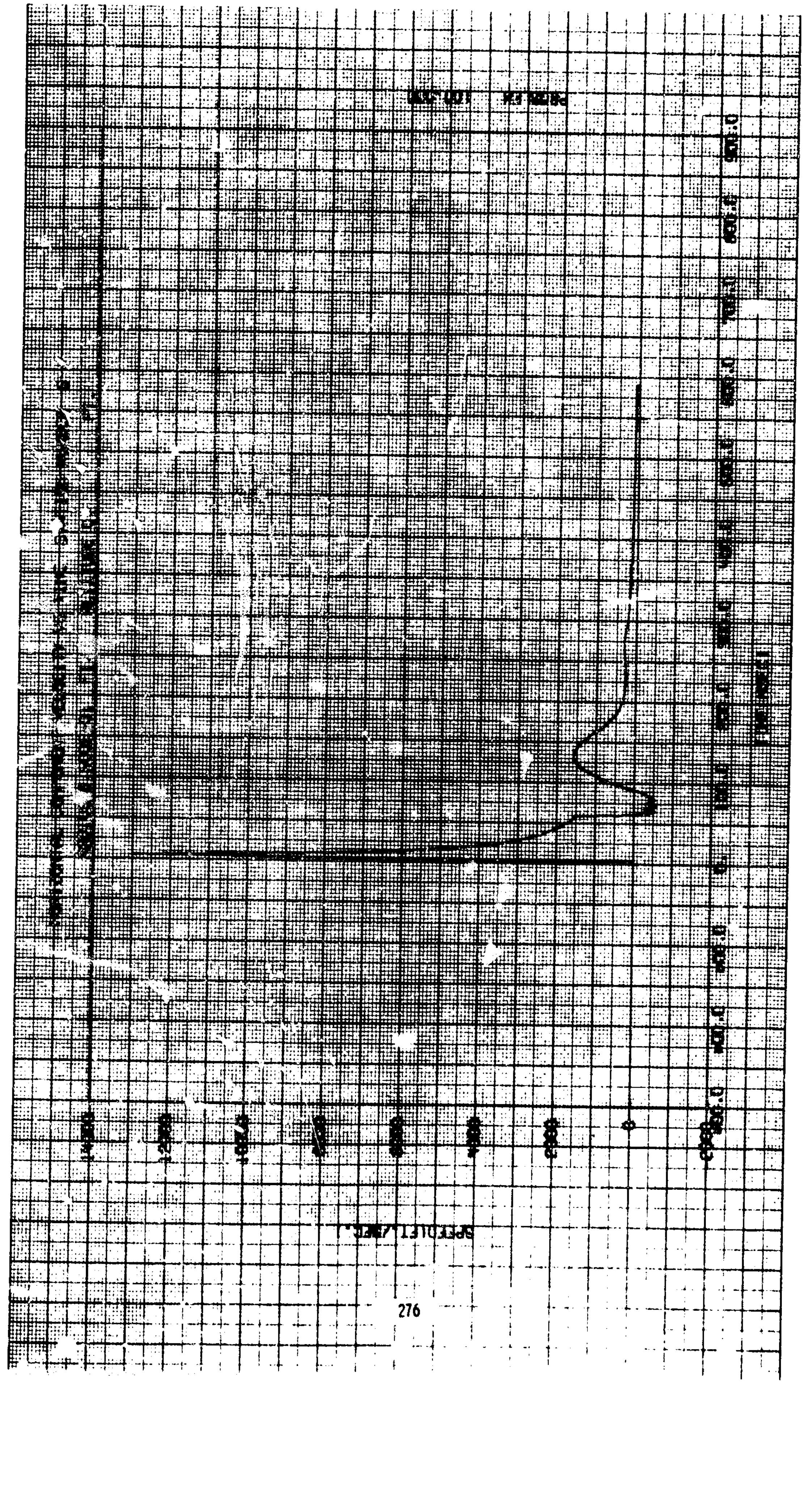

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 5
ALTITUDE 0 FT.
28000
24000
20000
16000
12000
8000
4000
0
-4000
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000

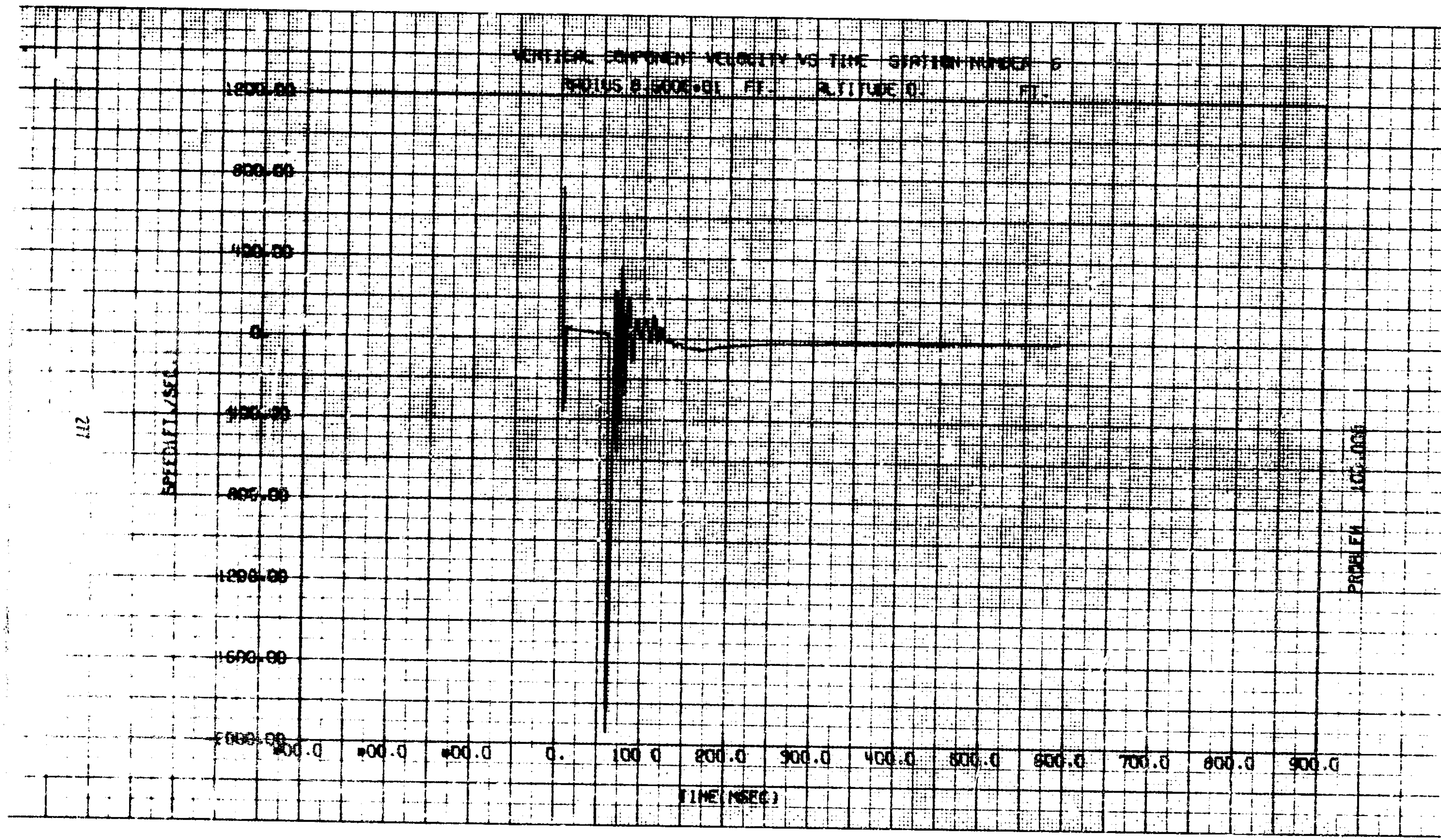

VERTICAL DYNAMIC PRESSURE VS TIME STATION NUMBER 5
RADIUS 6.9250E+01 FT. ALTITUDE 0. FT.
24.00
20.00
16.00
12.00
8.00
4.00
0.
-4.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM

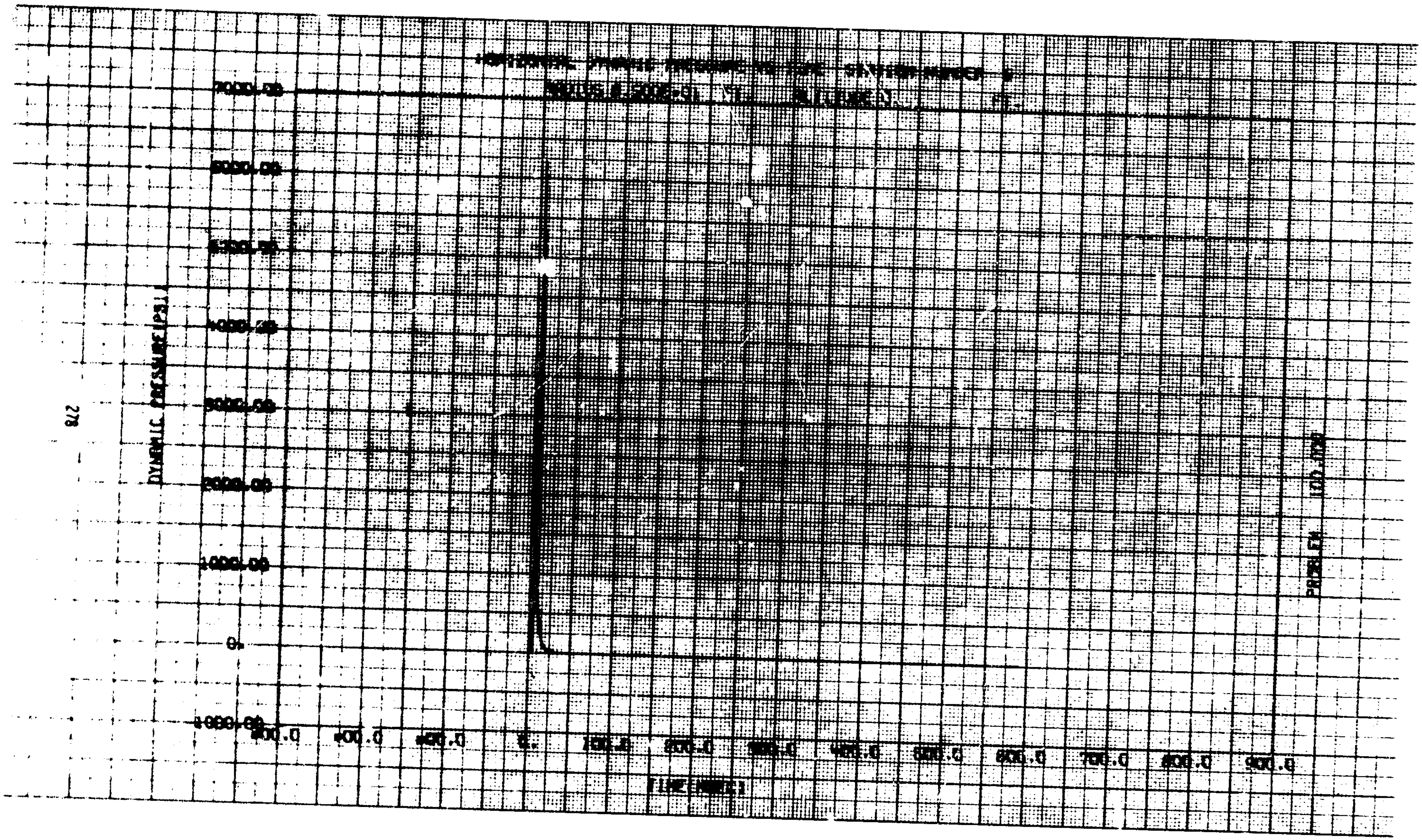

RADIUS 6.535E+01 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE
TIME(MSEC)
8.00
4.00
0.
-4.00
-8.00
-12.00
-16.00
-20.00
-24.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
100.000

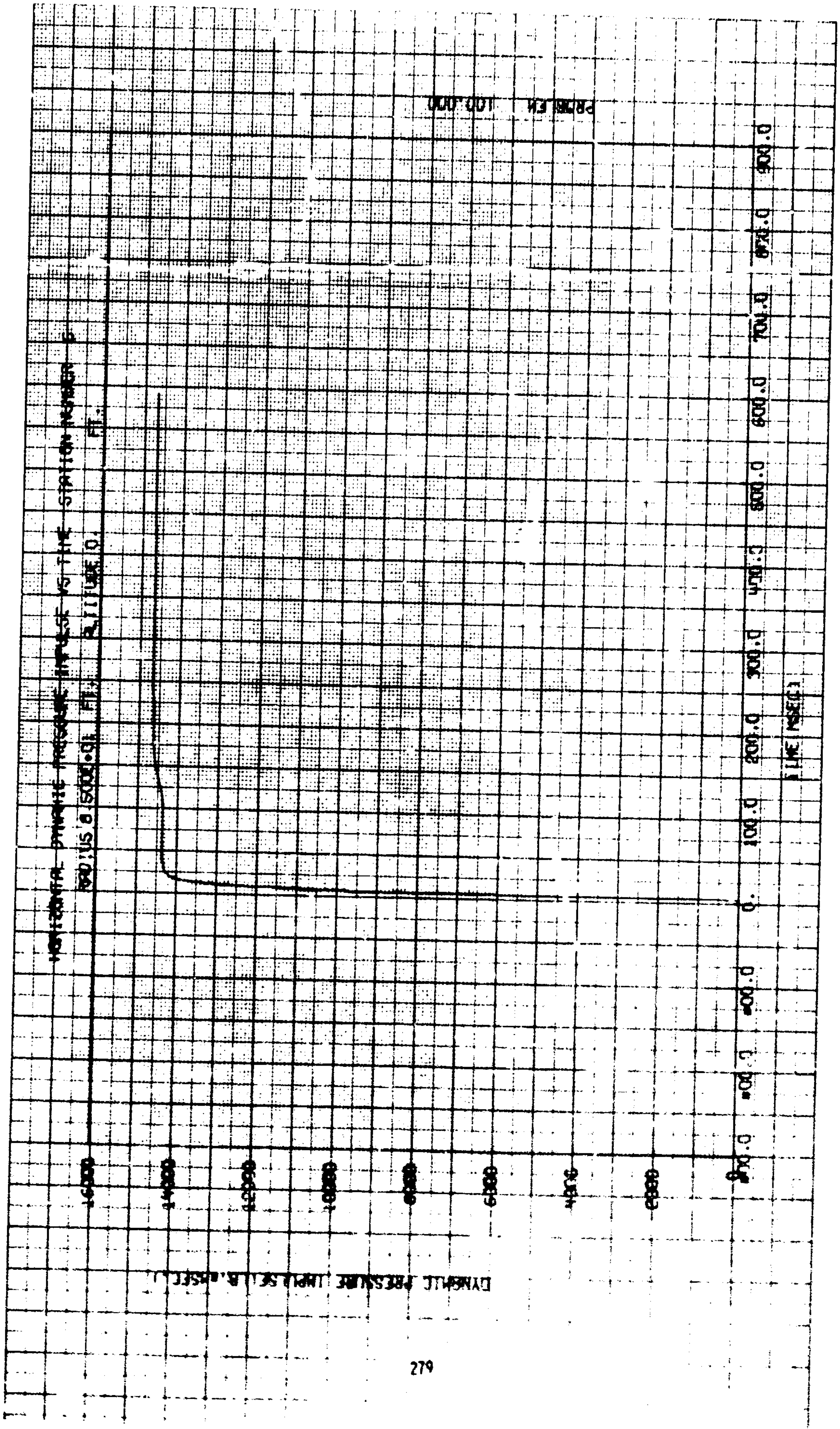


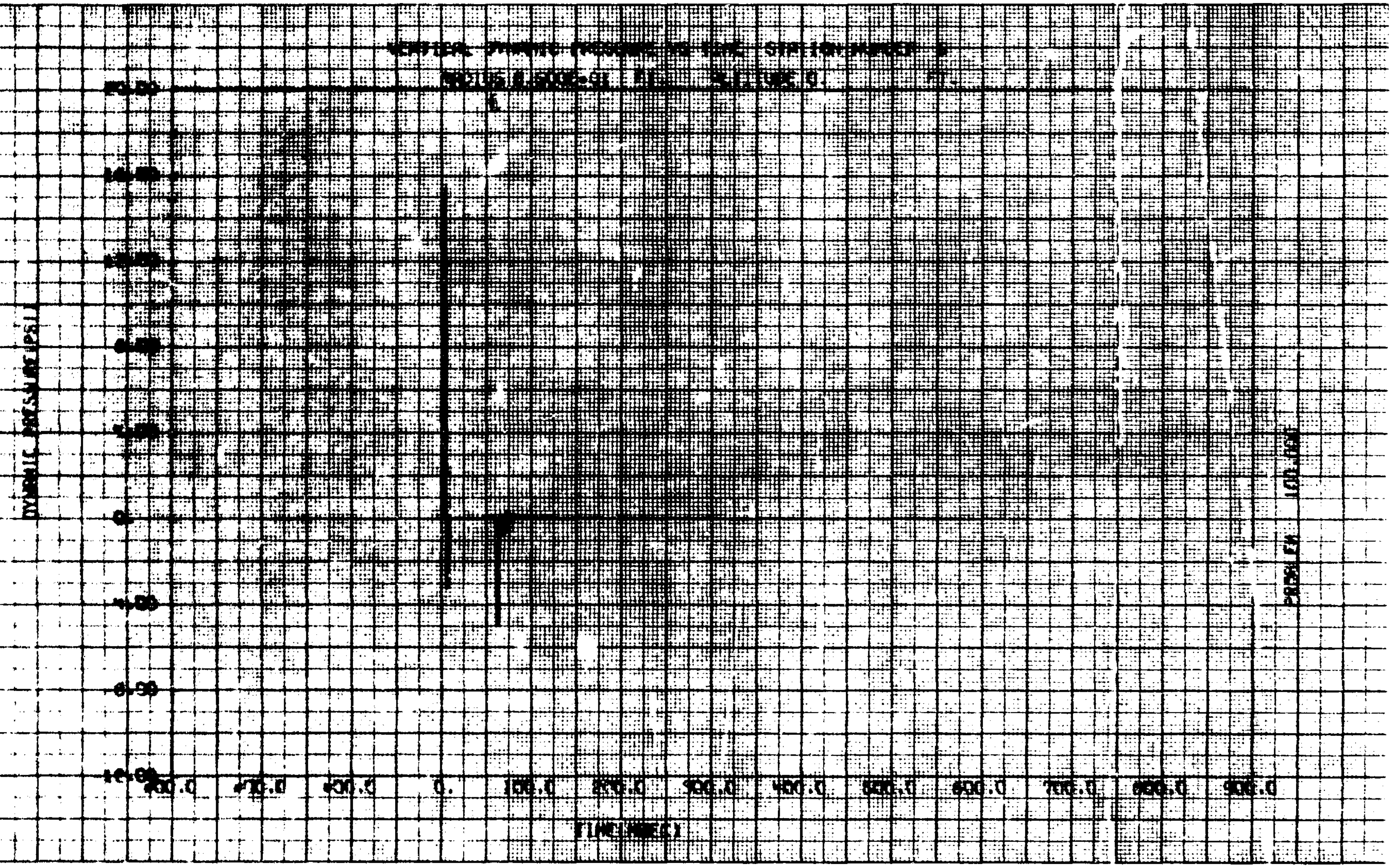

OVER PRESSURE IMPULSE VS TIME STATION NUMBER 6
FT. ALTITUDE 0. FT.
1200.00
1000.00
800.00
400.00
200.00
0.
-400.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
OVER PRESSURE IMPULSE(LB.-MSEC.)
PROBLEM 100.000

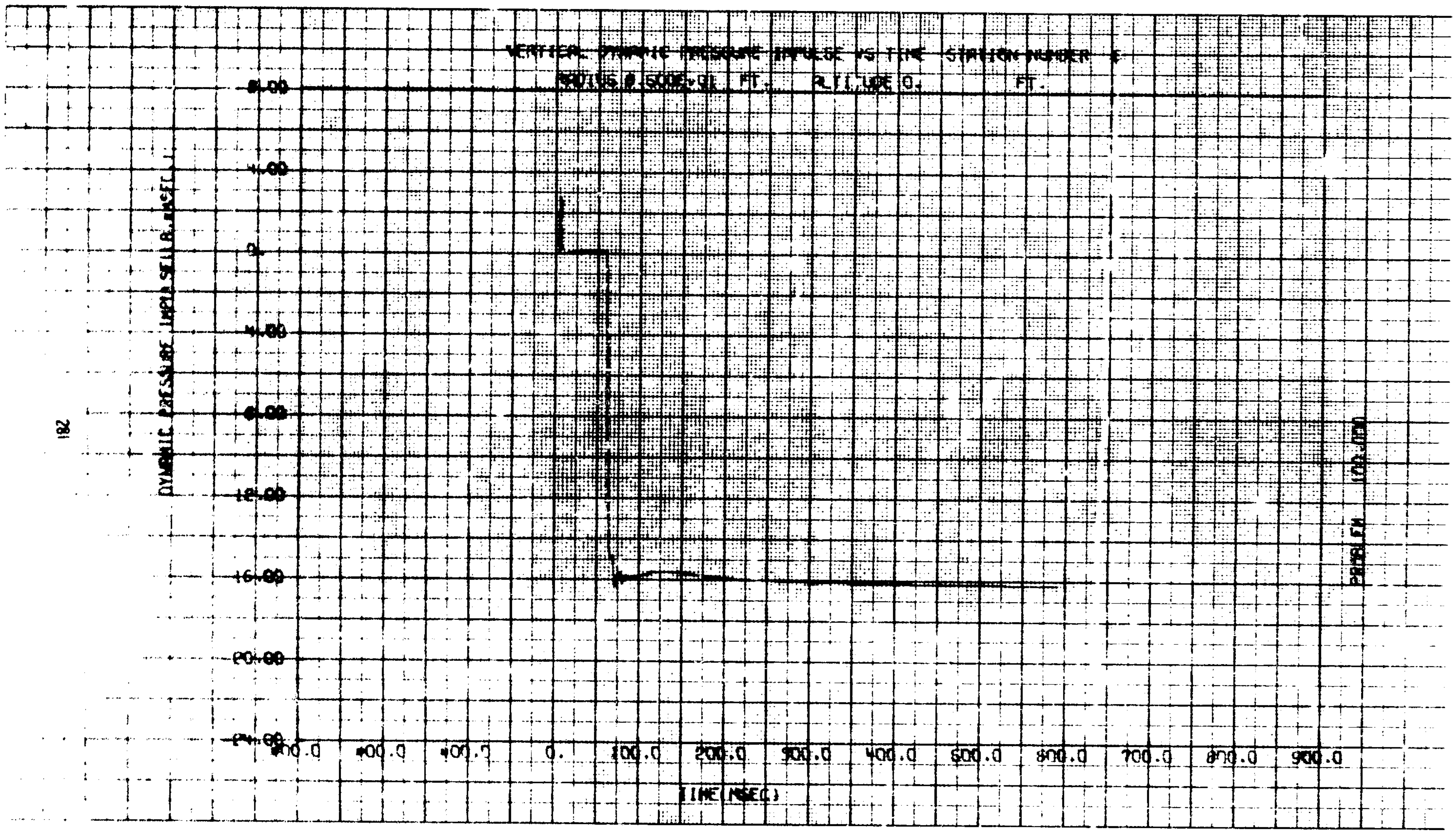


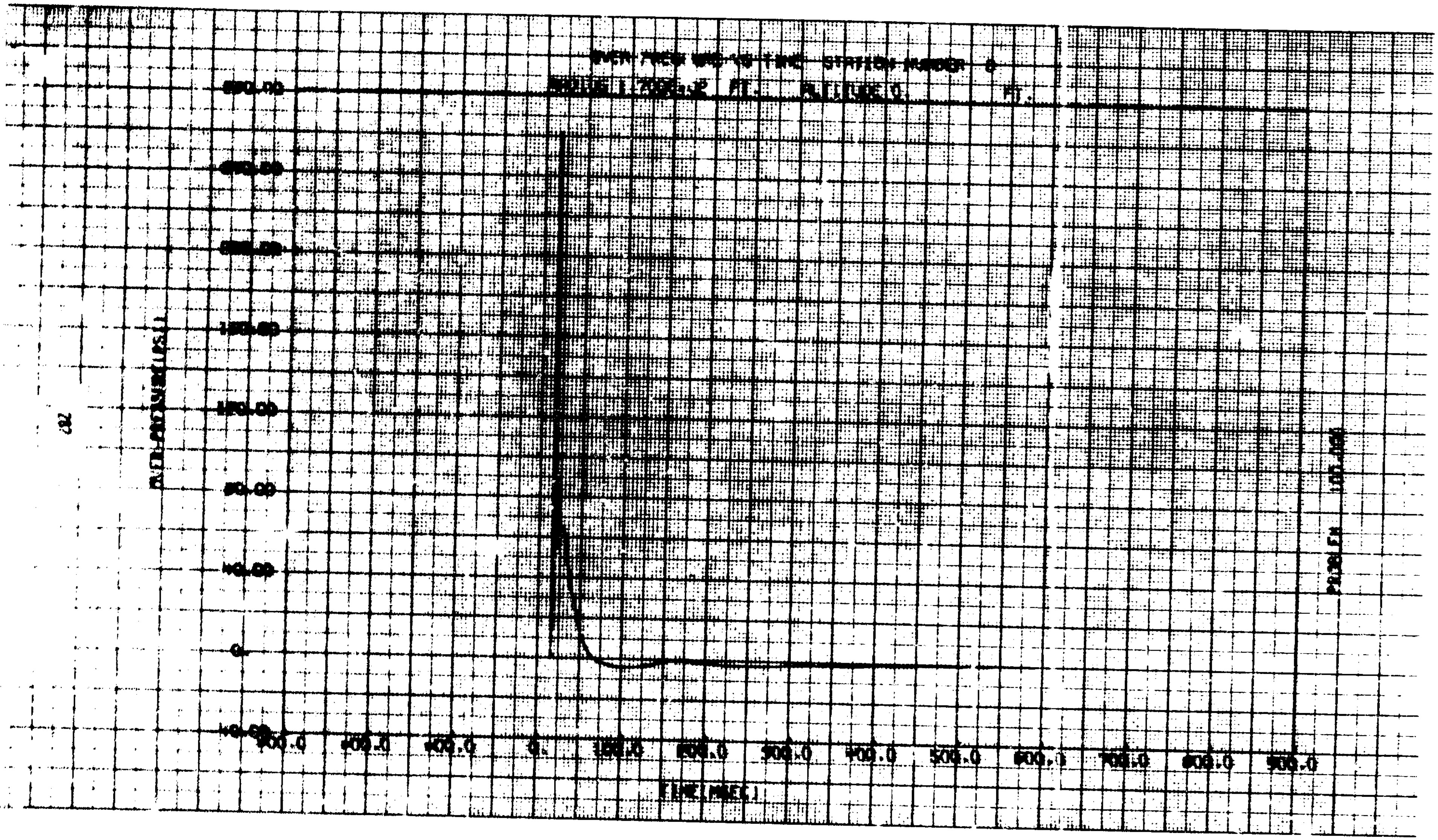

VERTICAL COMPONENT VELOCITY VS TIME STATION NUMBER 6
RADIUS 8.500E+01 FT. ALTITUDE 0. FT.
SPEED(FT./SEC.)
TIME(MSEC)
PROBLEM 100.006


PROBLEM 100.000
DYNAMIC PRESSURE(PSI)
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.
-1000.00
TIME(MSEC)
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0

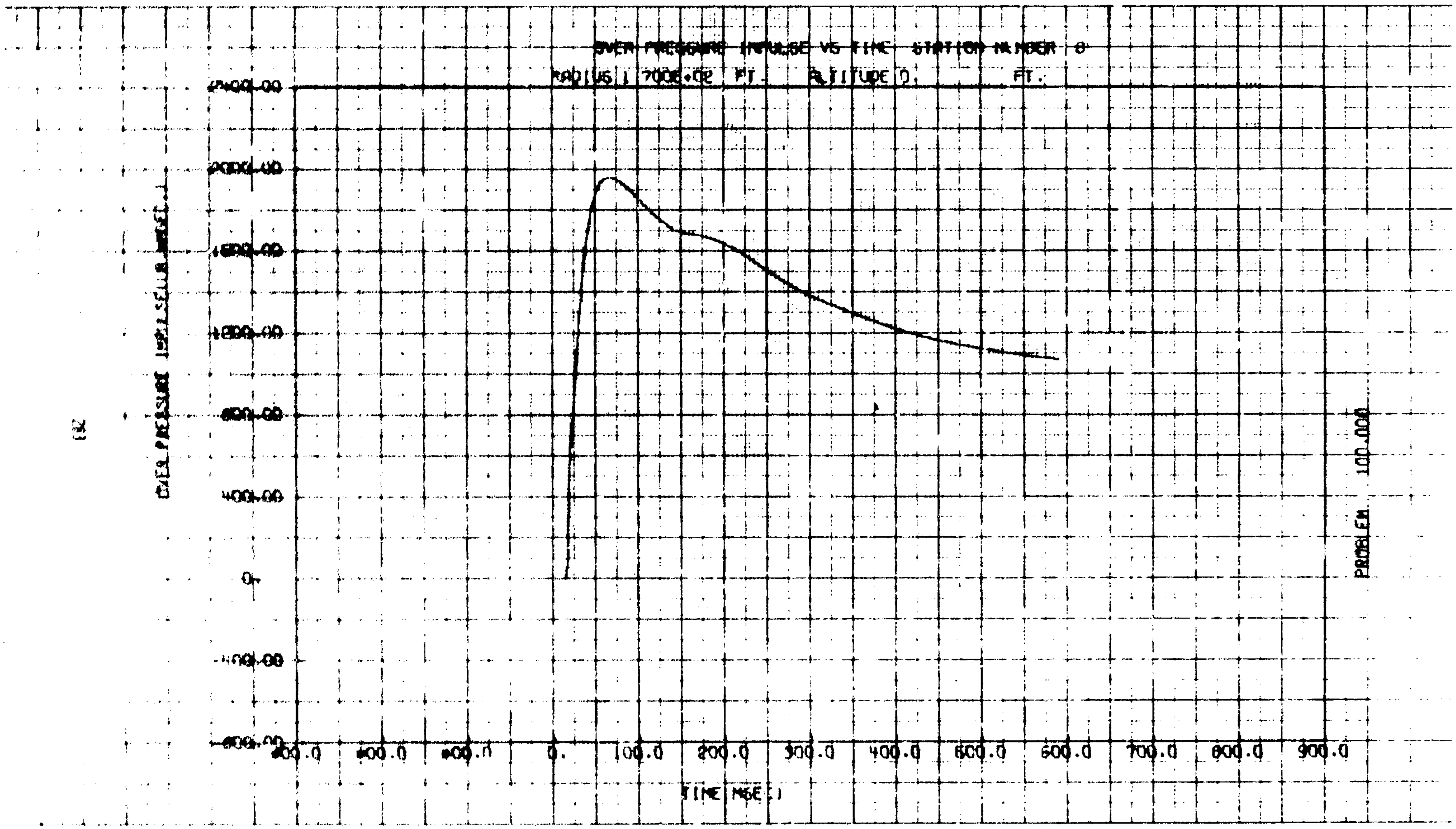

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER 5
ALTITUDE 0. FT.
TIME (MSEC)

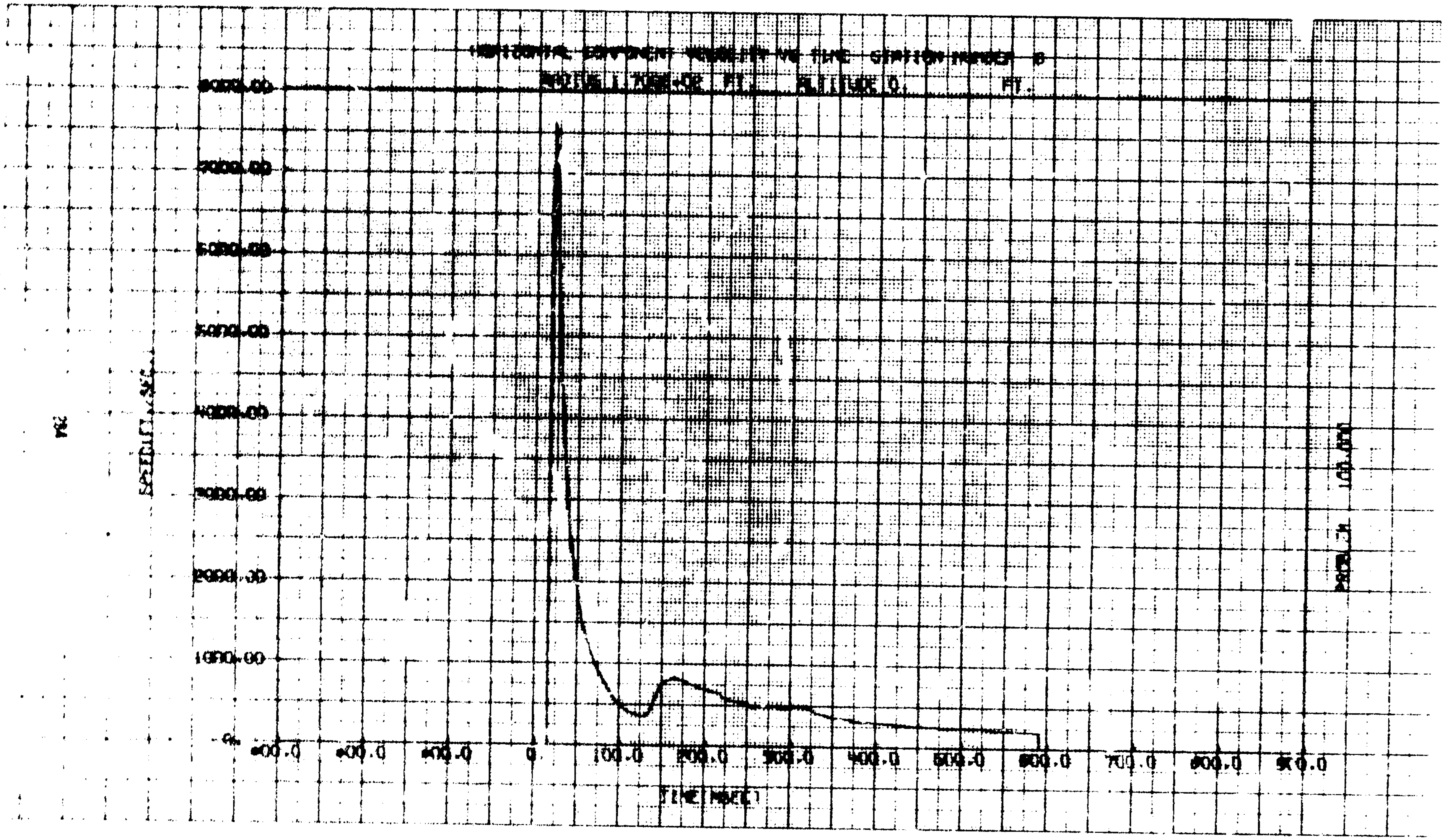

DYNAMIC PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000


VERTICAL DYNAMIC PRESSURE IMPULSE VS TIME STATION NUMBER
FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE IMPULSE
TIME(MSEC)
PROBLEM



TIME(MSEC)
PROBLEM


OVER PRESSURE IMPULSE VS TIME STATION NUMBER 8
RADIUS 1.7000+02 FT. ALTITUDE 0. FT.
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-800.00
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME (MSEC)
PROBLEM 100.000


FT.
TIME (MSEC)
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
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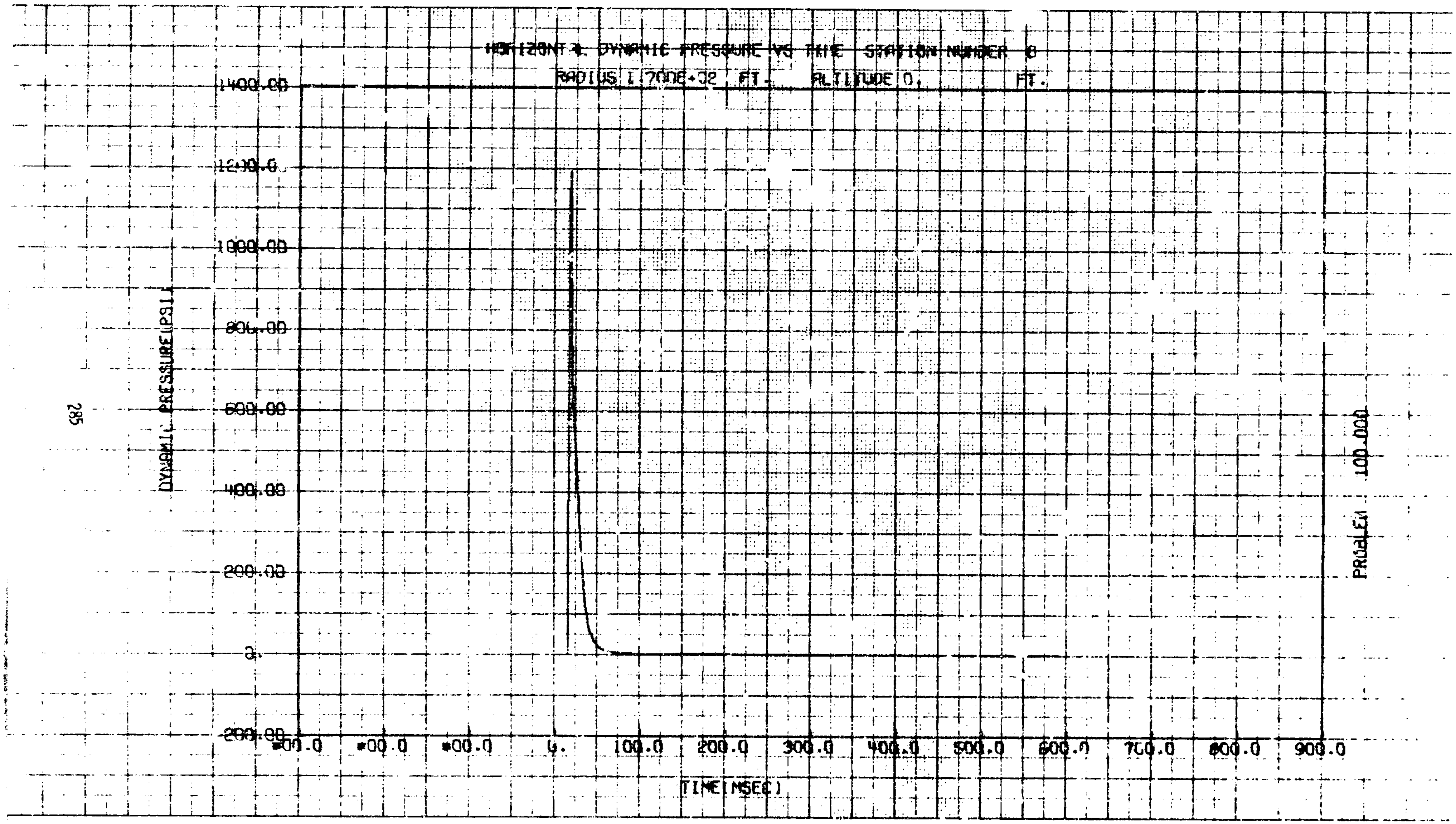
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800.00
600.00
400.00
200.00
0.
-200.00
-300.0
-200.0
-100.0
0.
100.0
200.0
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600.0
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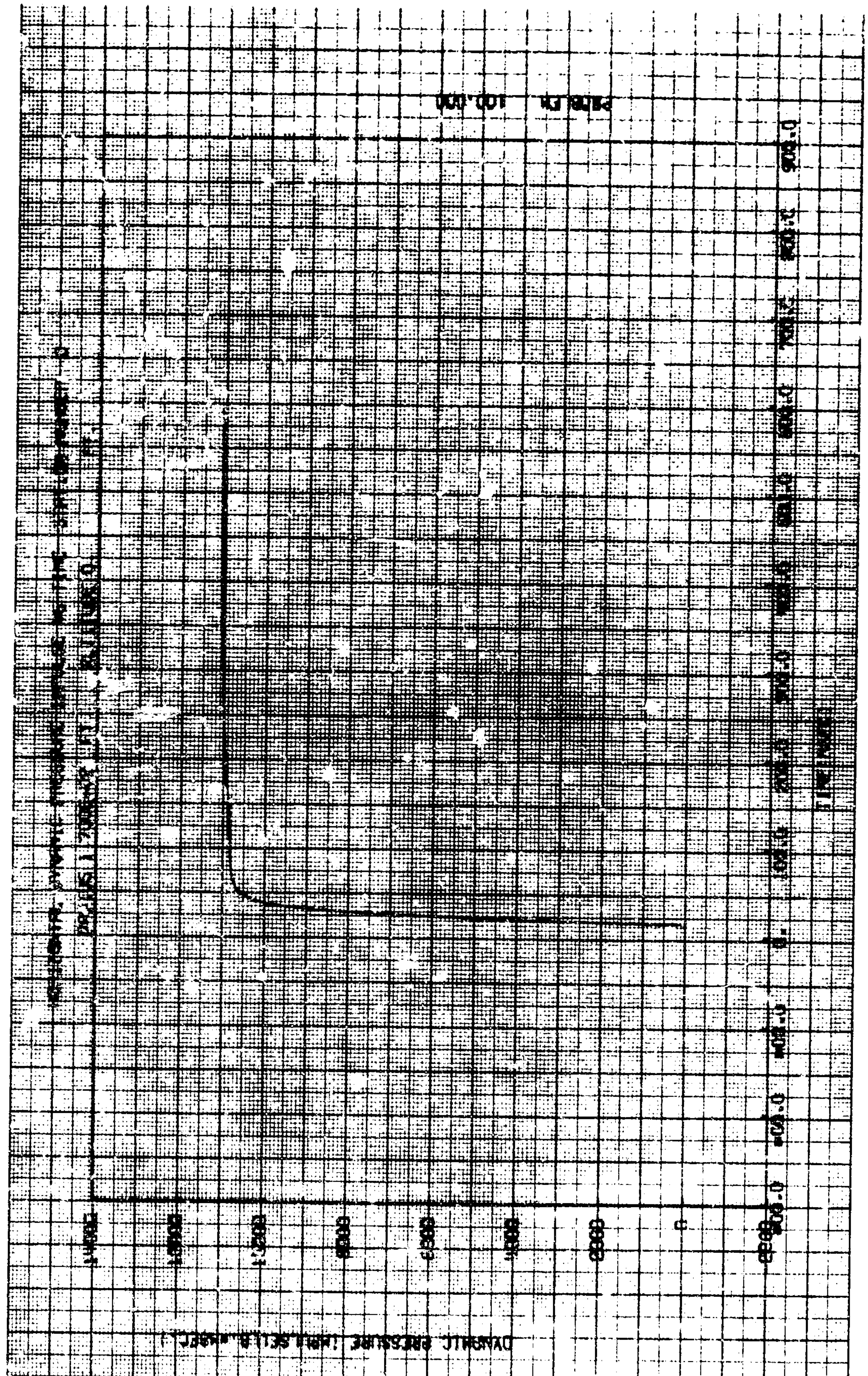
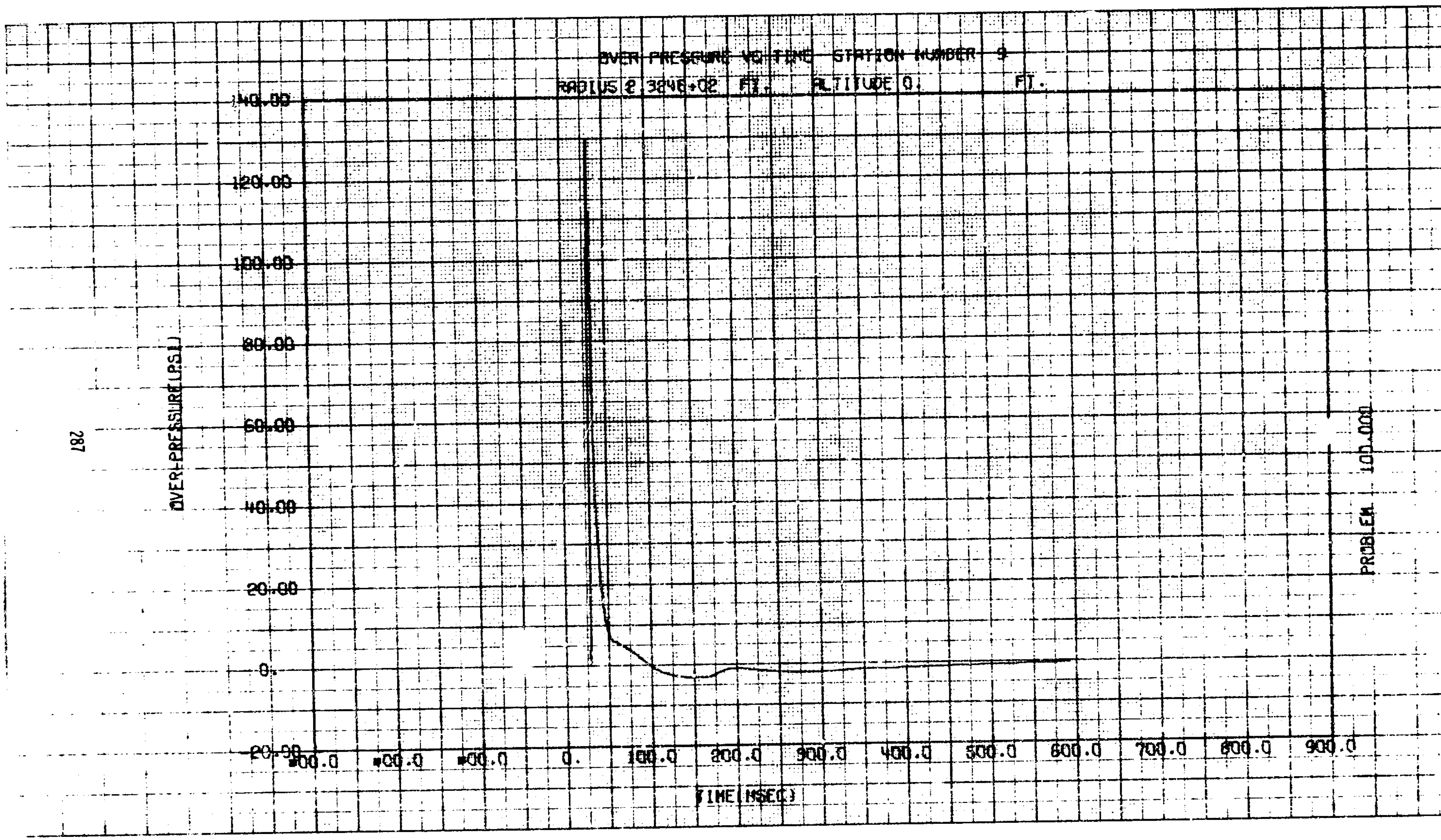
800.0
900.0
DYNAMIC PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000

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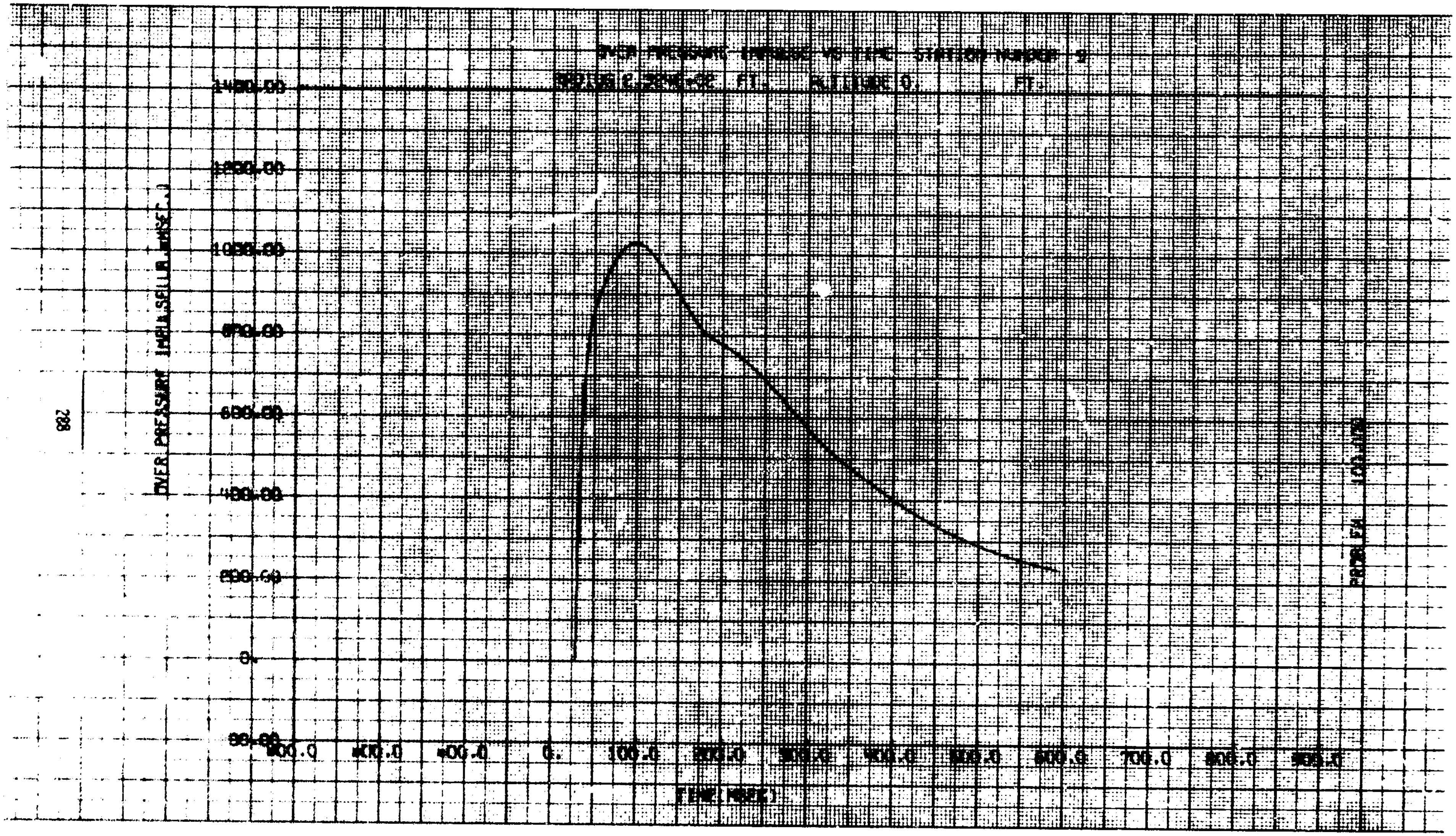
120.00
100.00
80.00
60.00
40.00
20.00
0.
-20.00
OVER-PRESSURE(PSI)
0.
100.0
200.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000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0.
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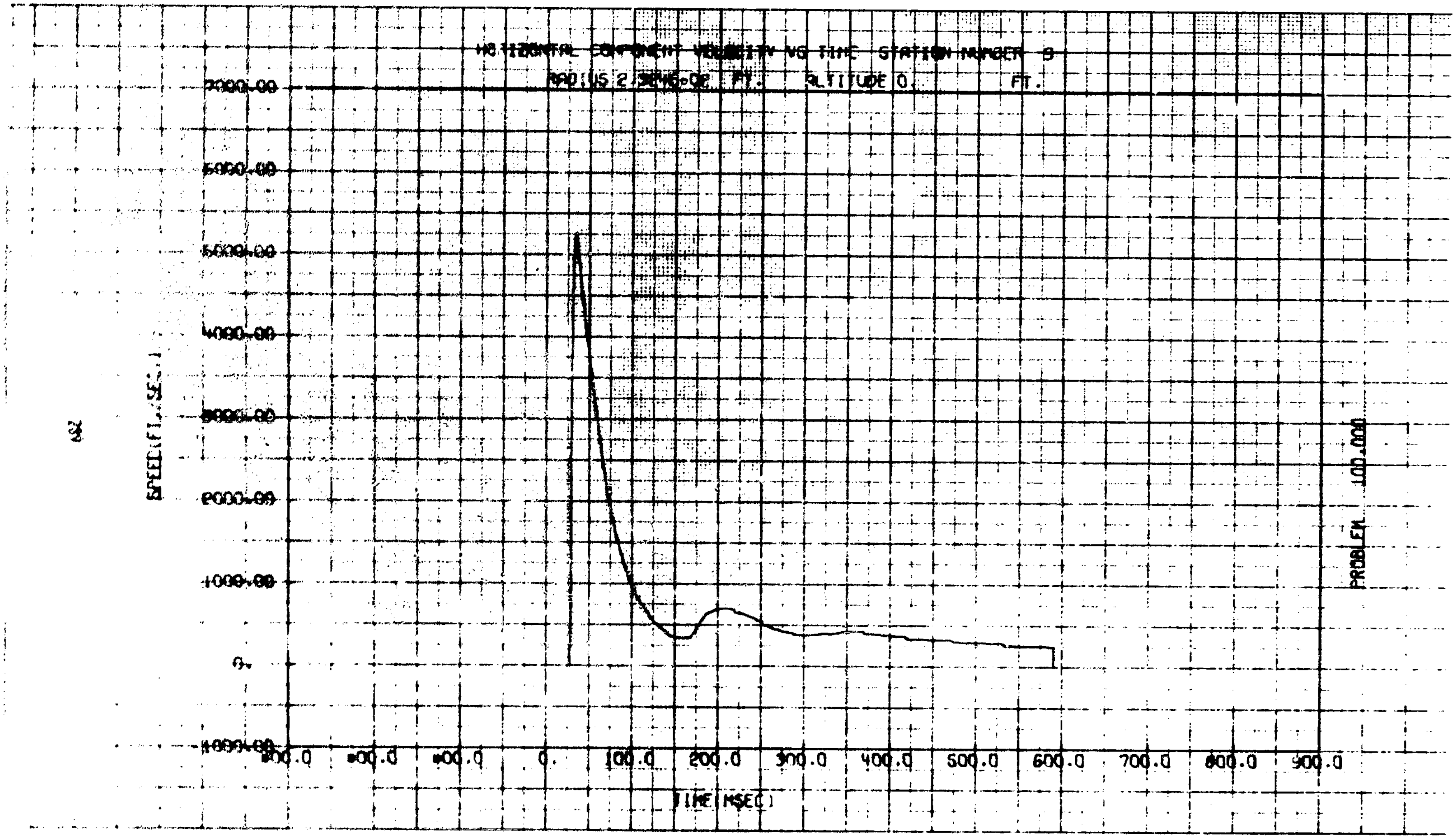
700.0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RADIUS
FT.
ALTITUDE 0.
FT.
SPEED(FT/SEC)
TIME(MSEC)
PROBLEM 100.000
0.
100.0
200.0
300.0
400.0
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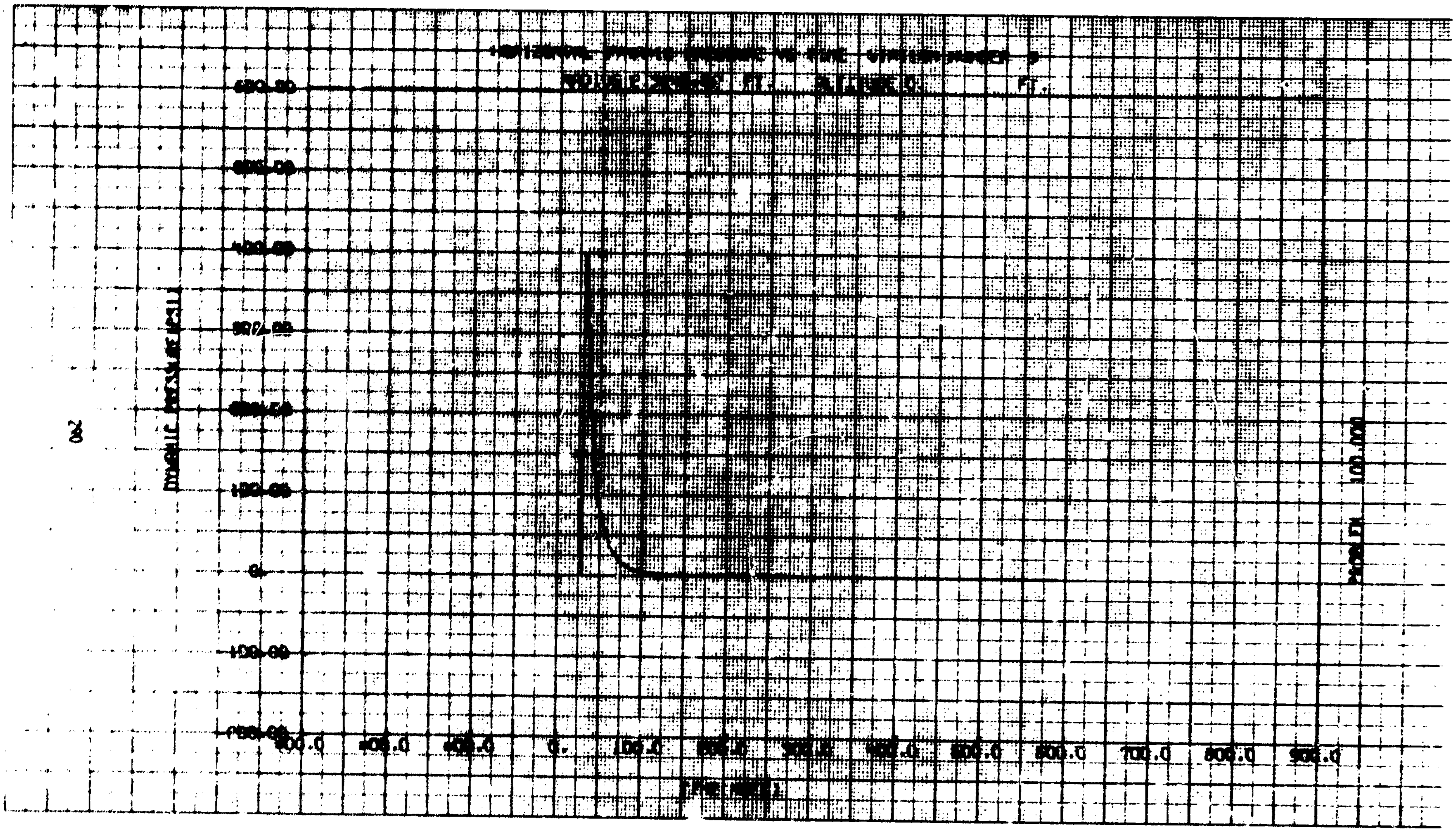
DYNAMIC PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
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500.00
400.00
300.00
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-100.00
-200.00
-300.0
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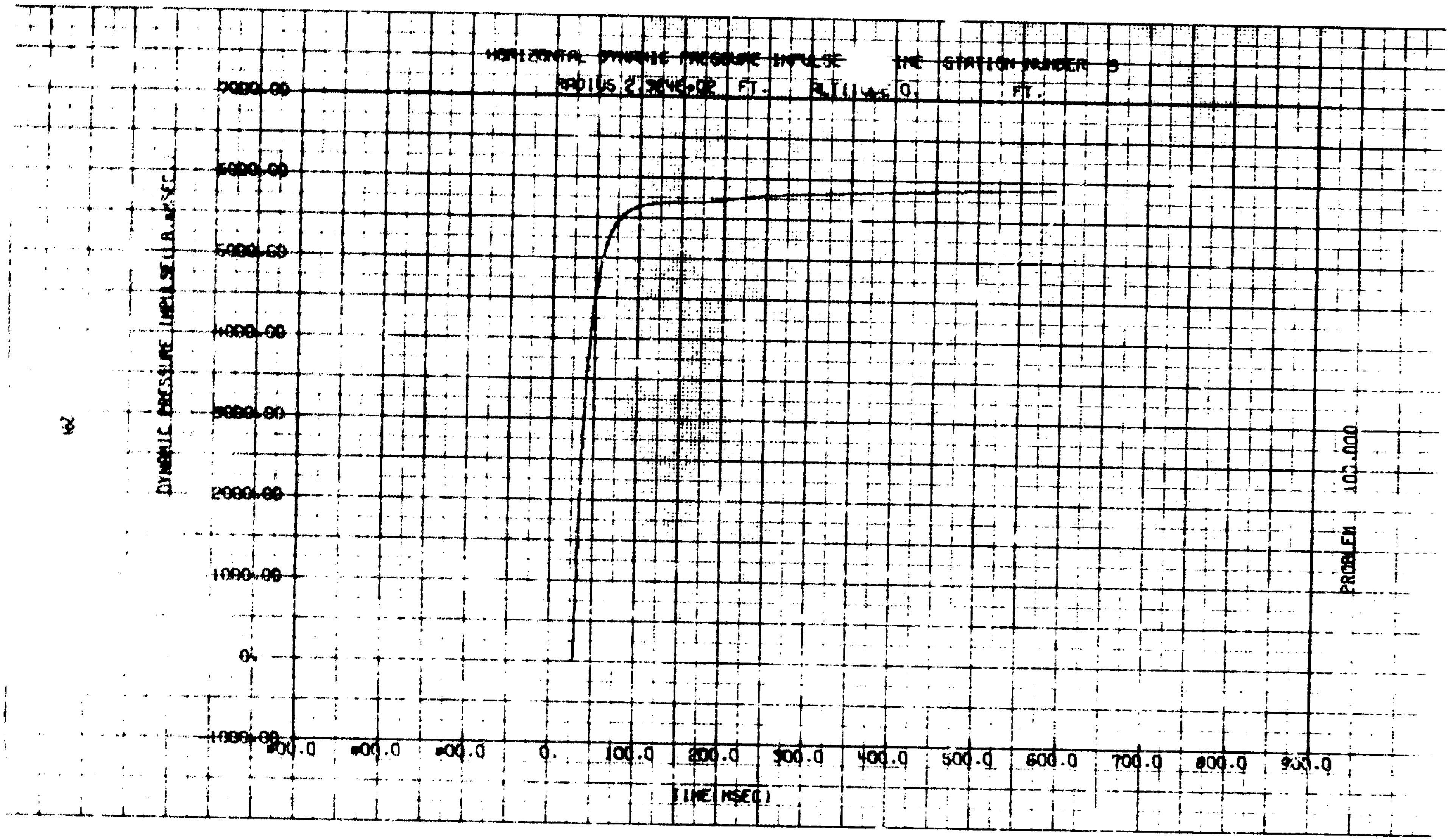
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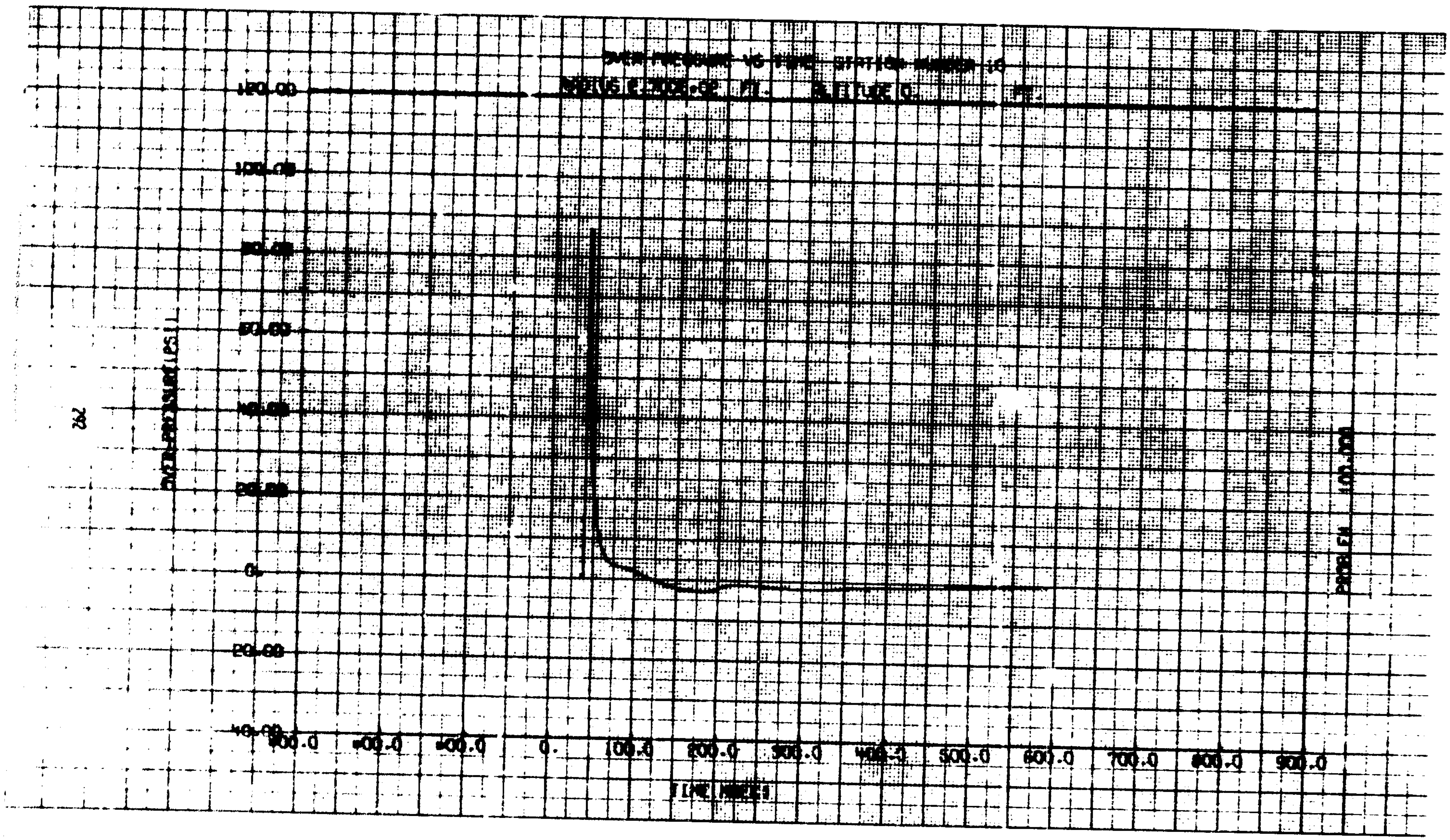
FT.
DYNAMIC PRESSURE IMPULSE(LB-MSEC)
TIME(MSEC)
PROBLEM 103.000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-100.0
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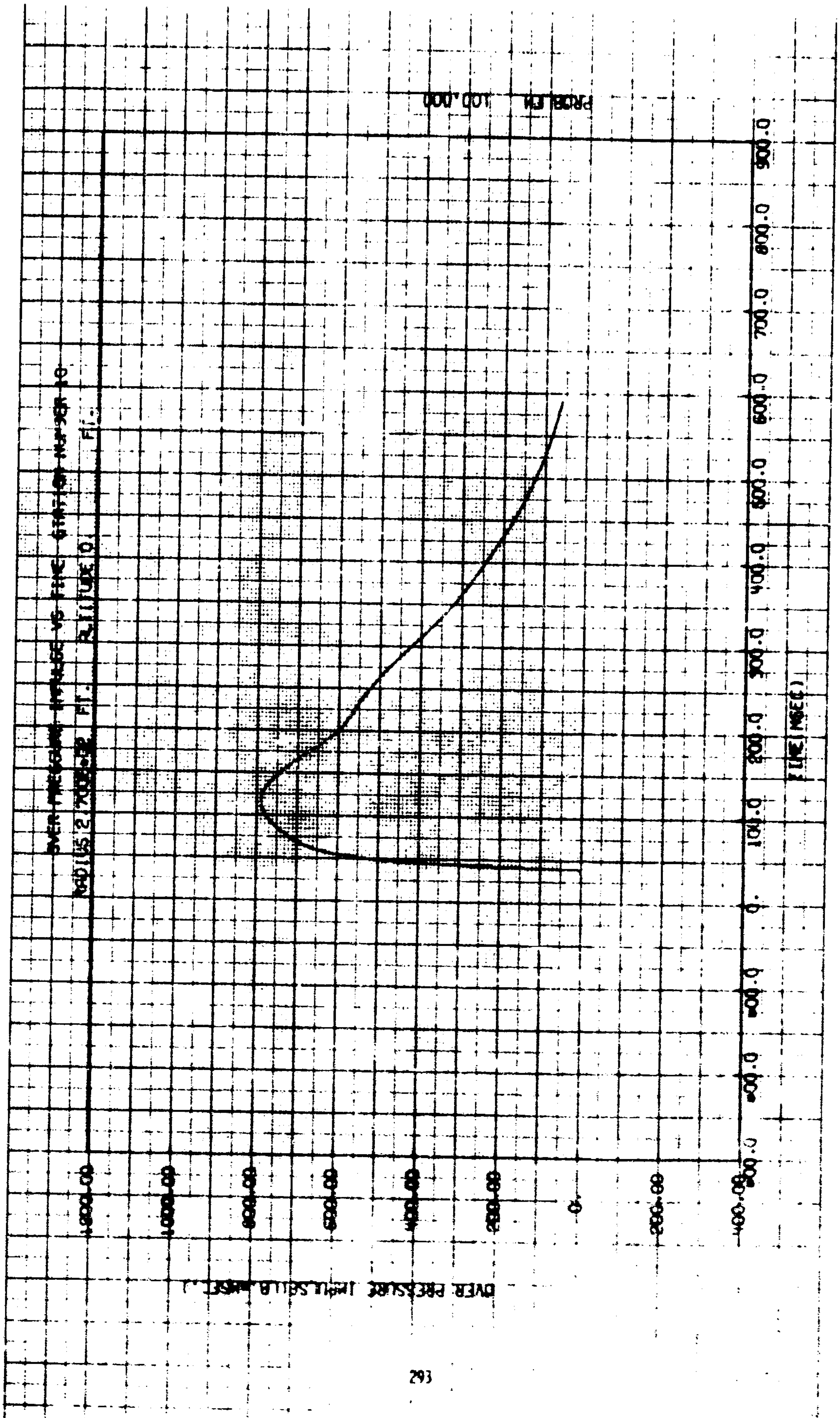
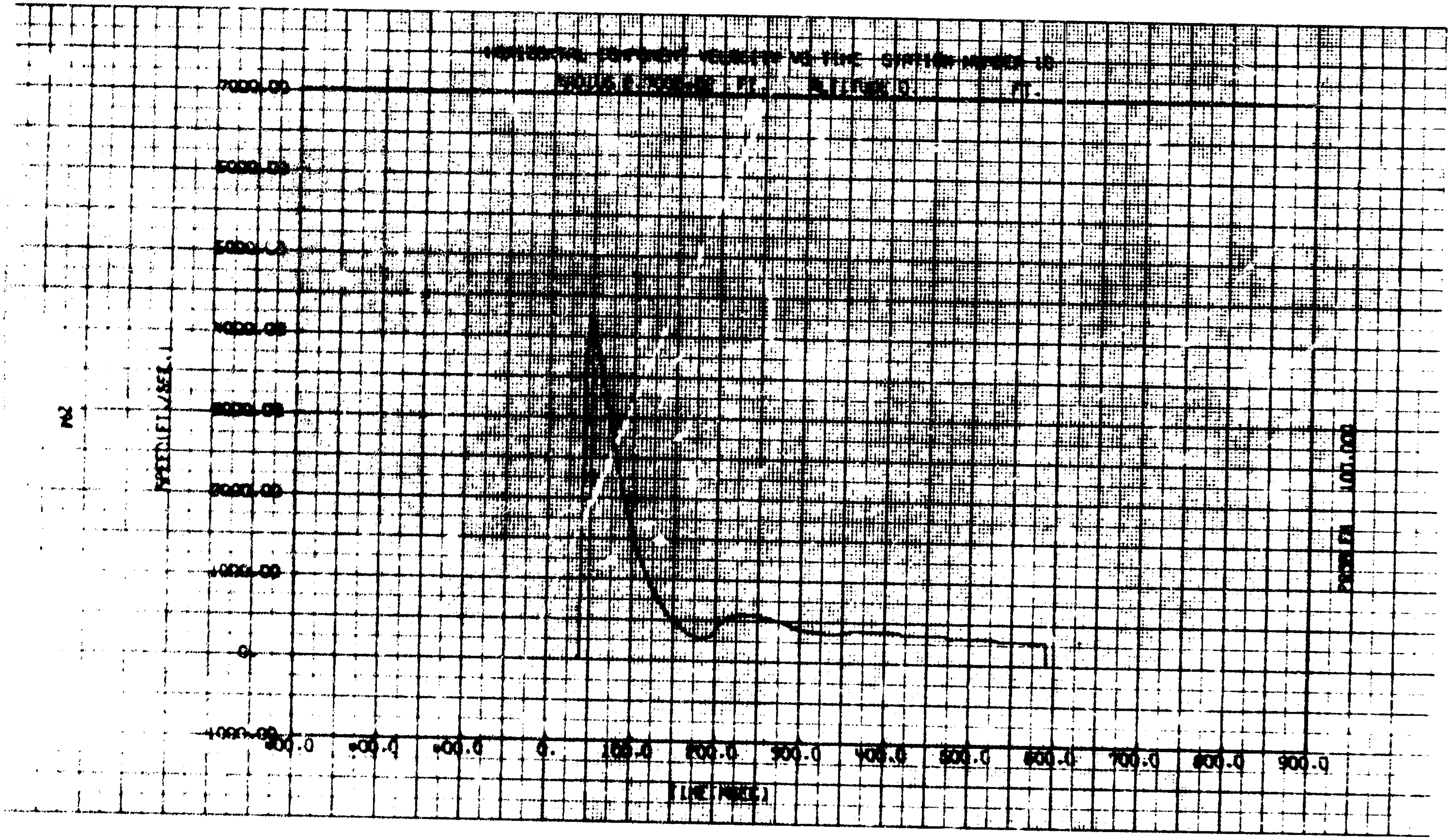
TIME (MSEC)
PROBLEM 100.000


PROBLEM 100.000
TIME (MSEC)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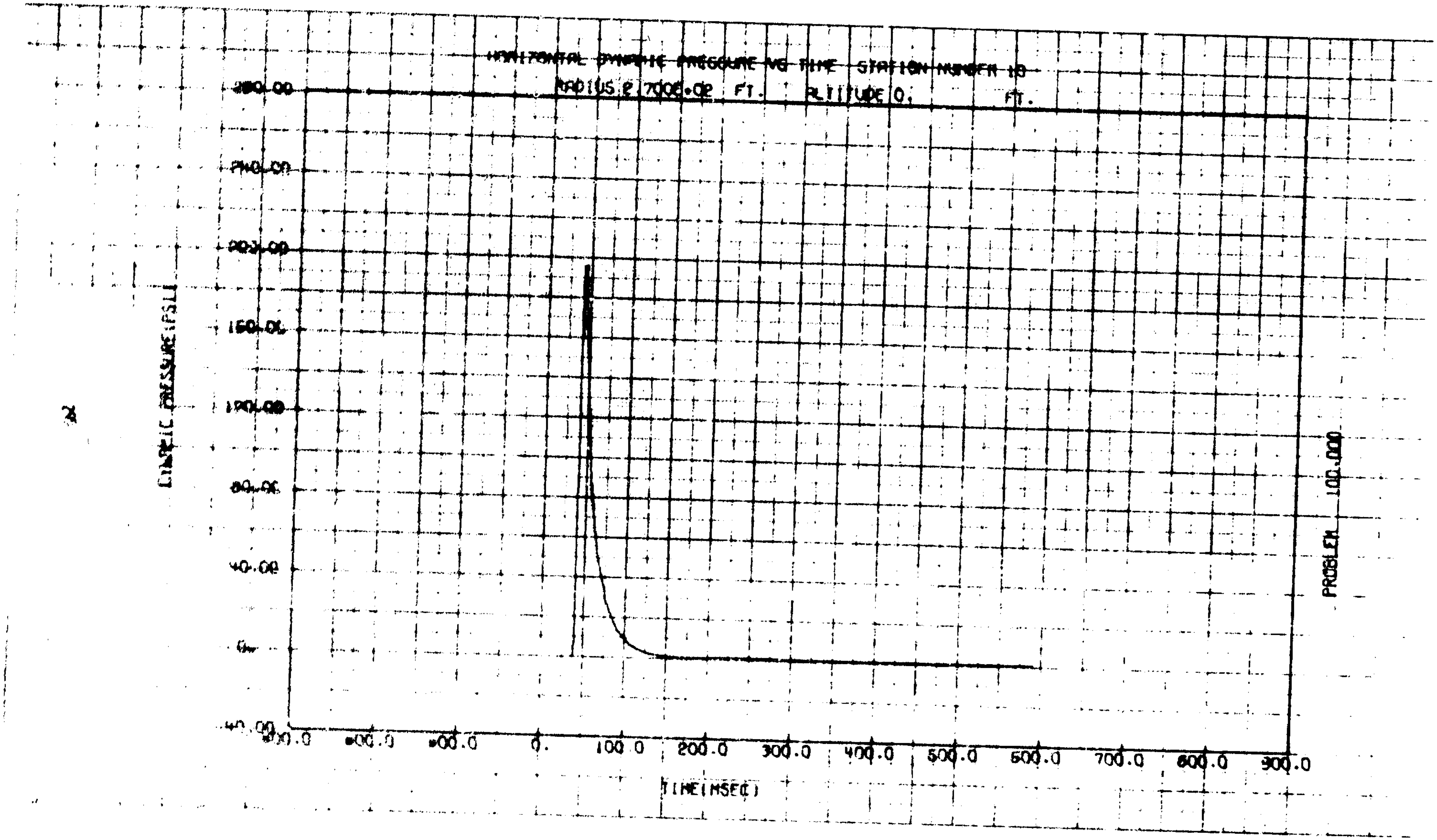
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RADIUS 2.7000E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
TIME(MSEC)
PROBLEM 100.000
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100.0
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700.0
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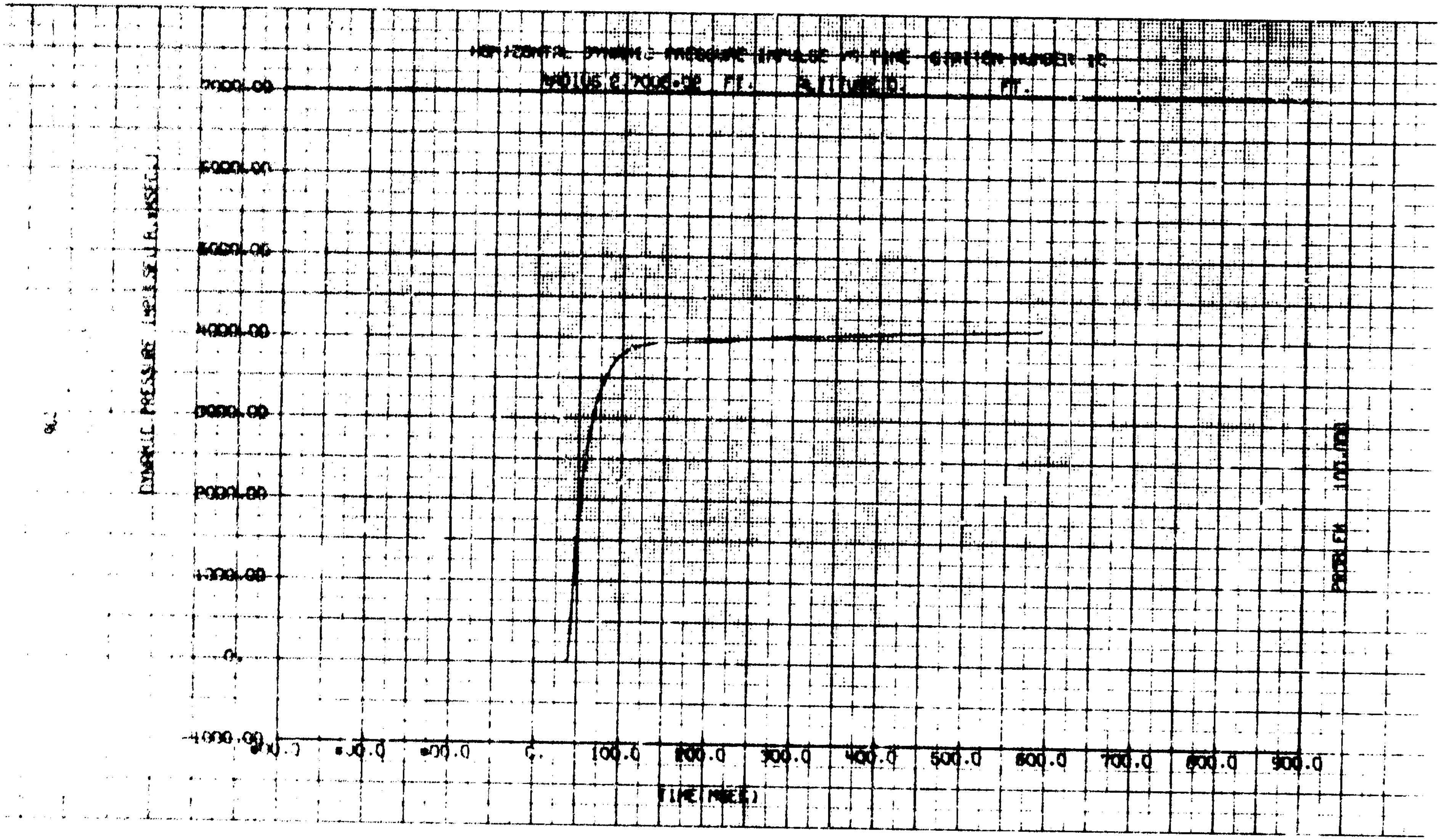

HORIZONTAL DYNAMIC PRESSURE IMPULSE VS TIME
PROBLEM 101.000
DYNAMIC PRESSURE IMPULSE
TIME (MSEC)
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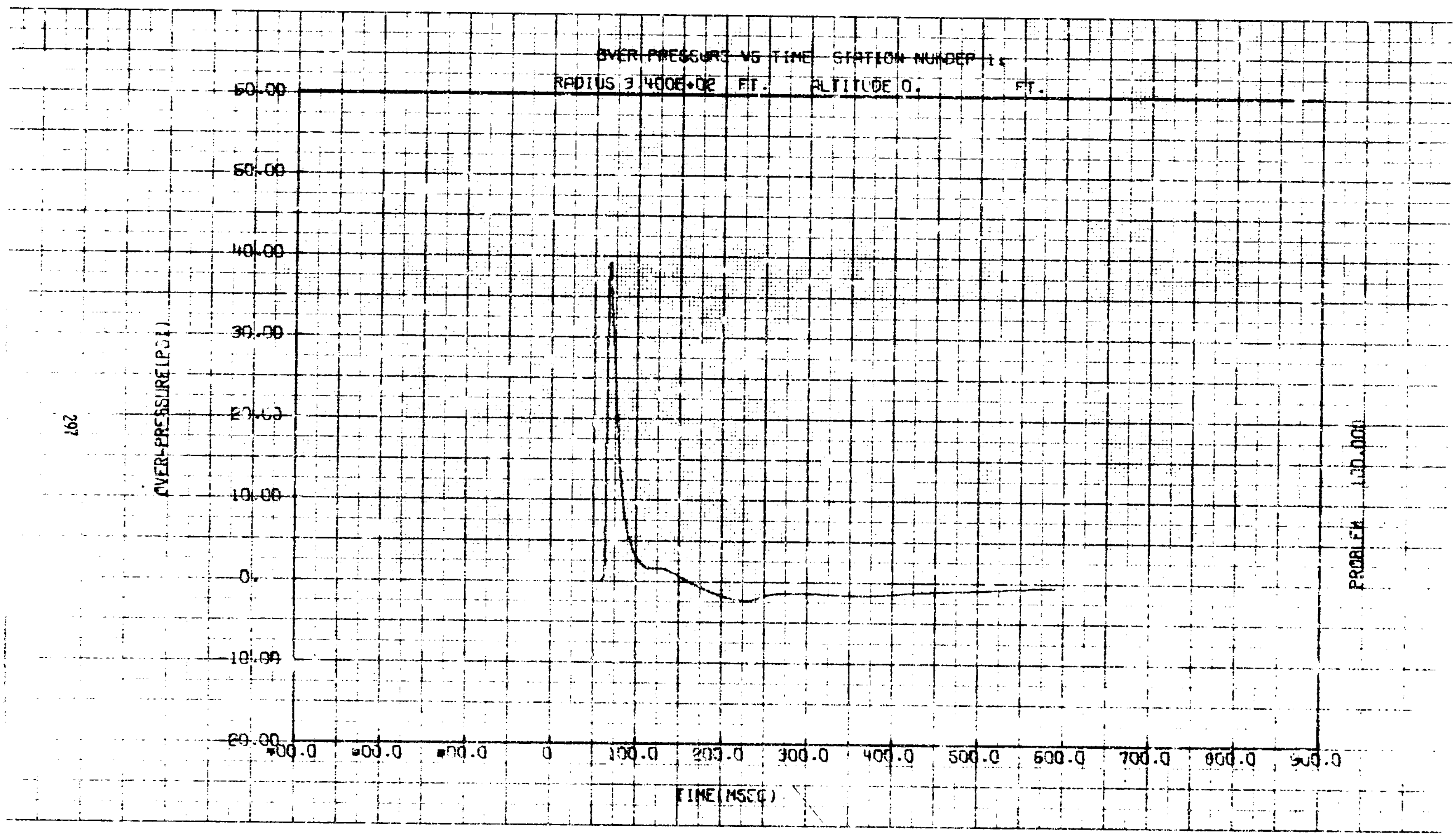
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40.00
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10.00
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600.0
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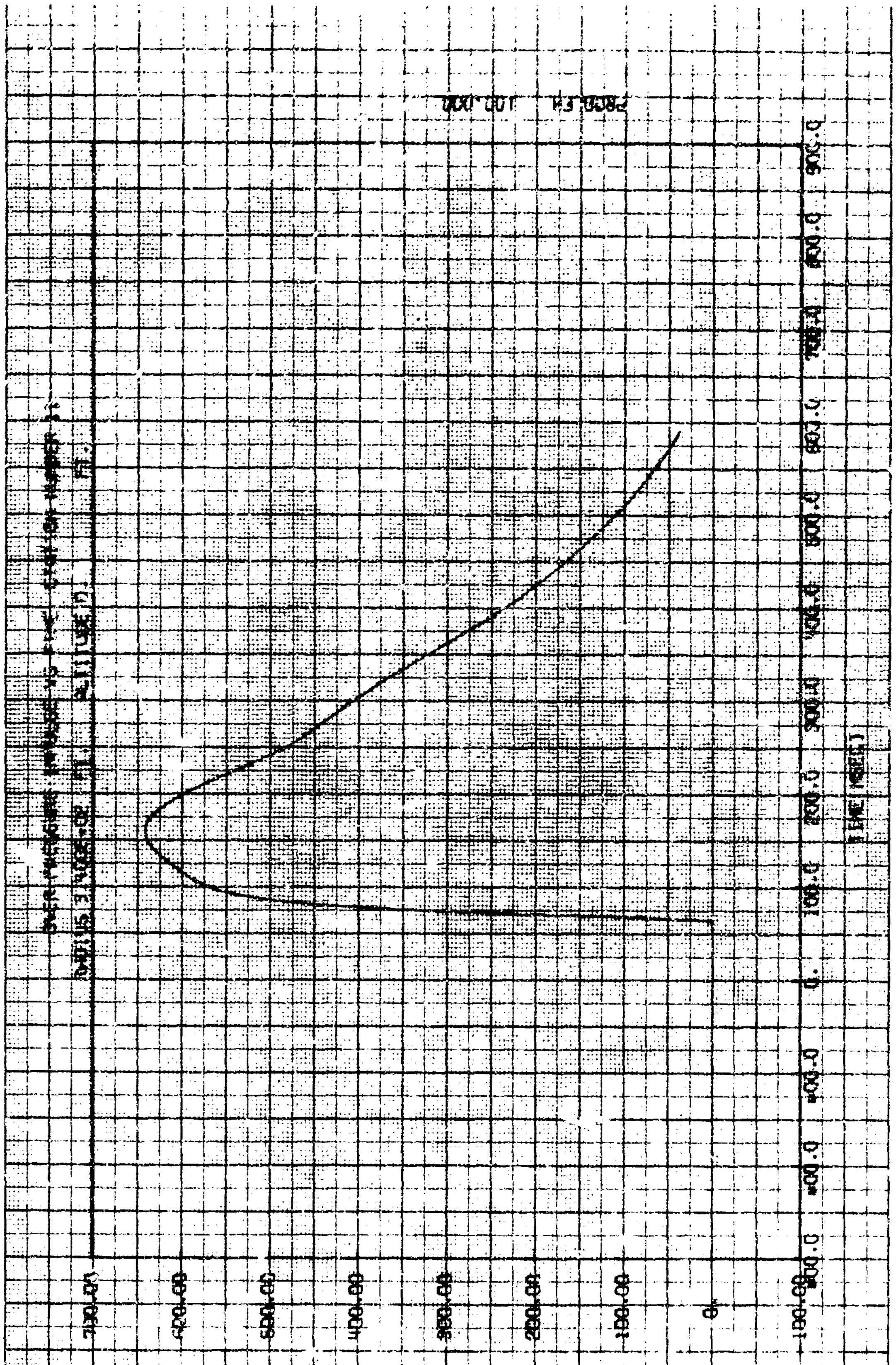
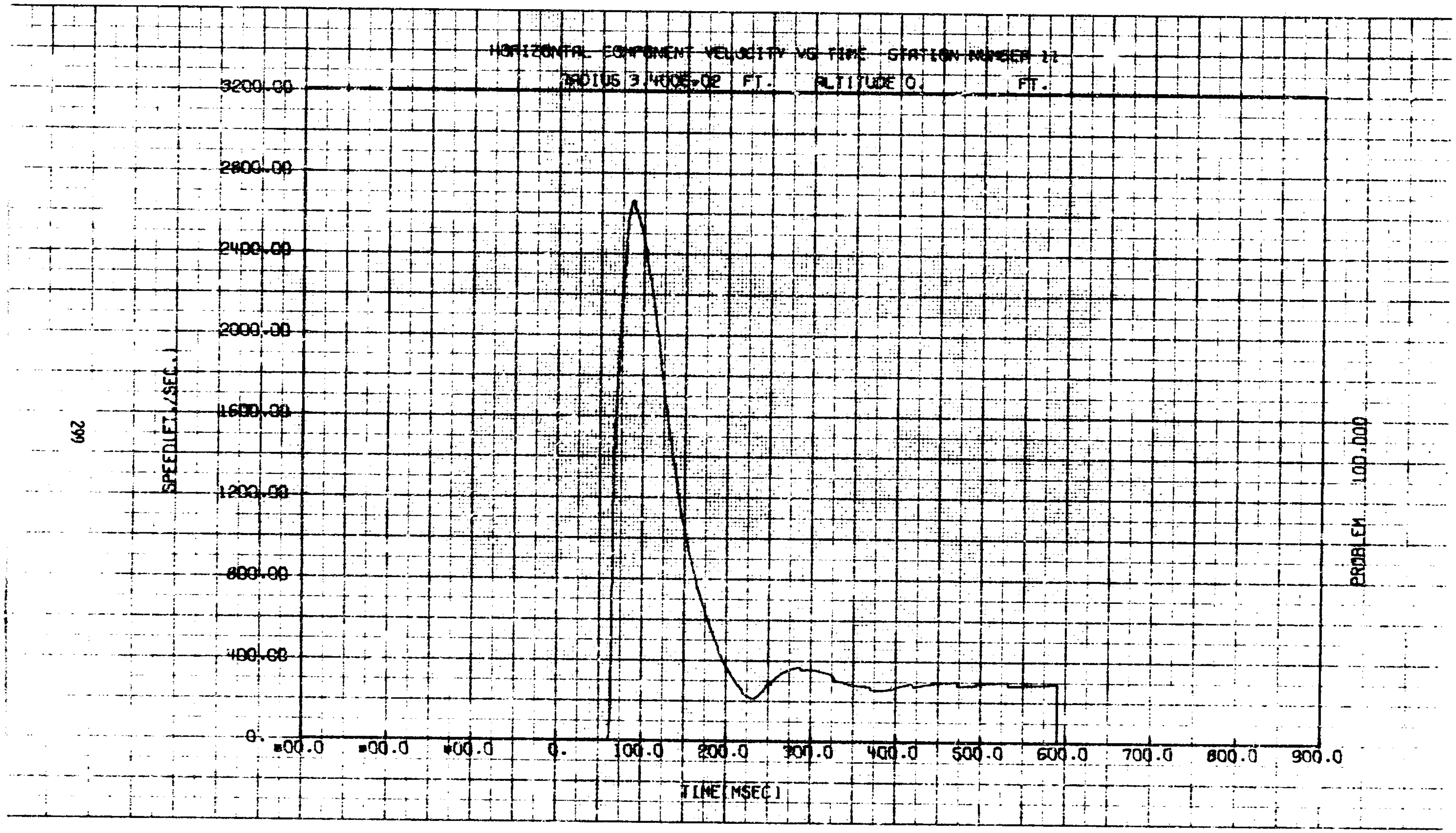
TIME(MSEC)
OVER-PRESSURE(PSI)

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SPEED(FT./SEC.)
TIME(MSEC)
PROBLEM 100.000
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2800.00
2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
0.
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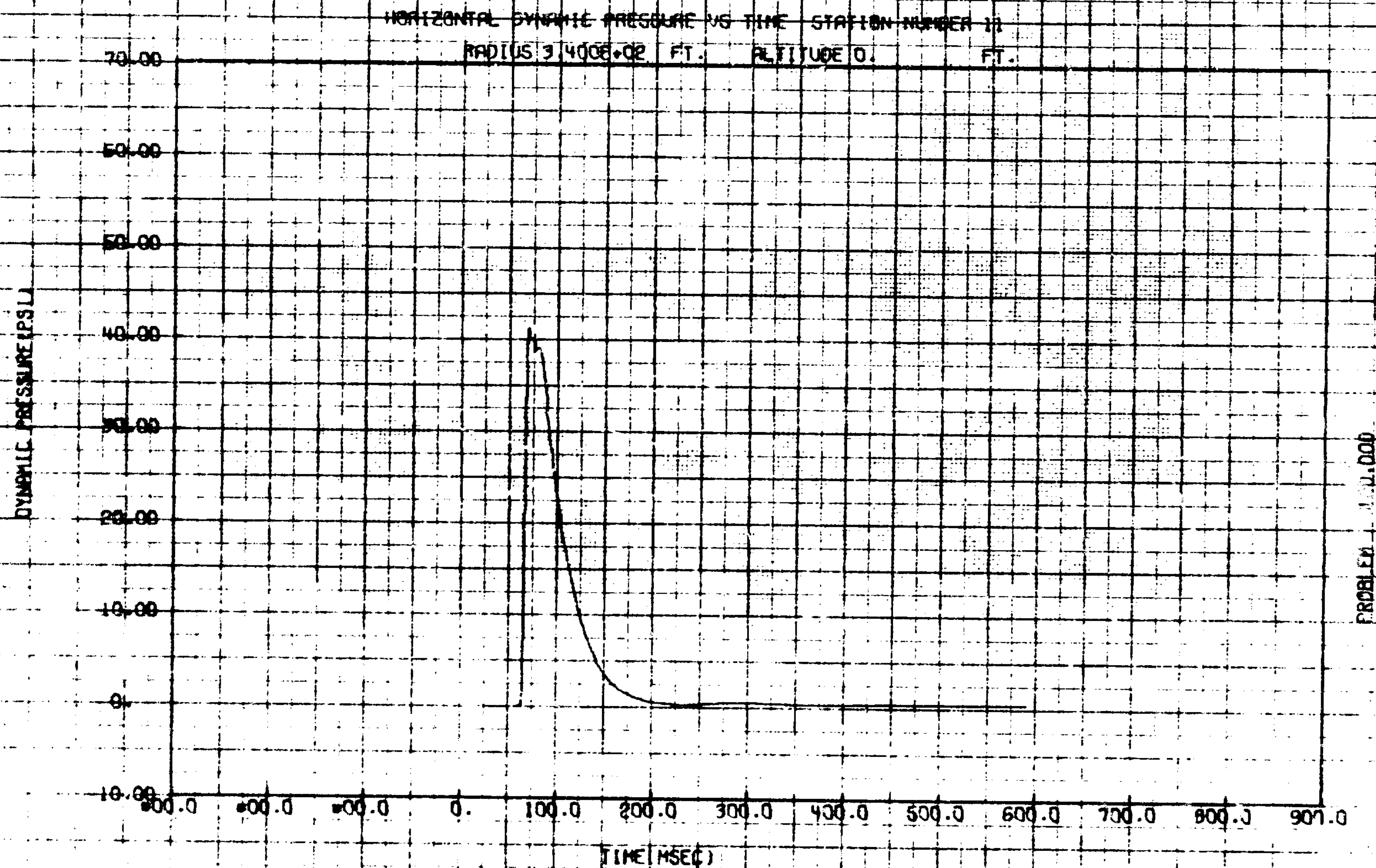
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RADIUS 3.400E+02 FT. ALTITUDE 0. FT.
DYNAMIC PRESSURE(PSI)
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60.00
50.00
40.00
30.00
20.00
10.00
0.
-10.00
TIME(MSEC)
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100.0
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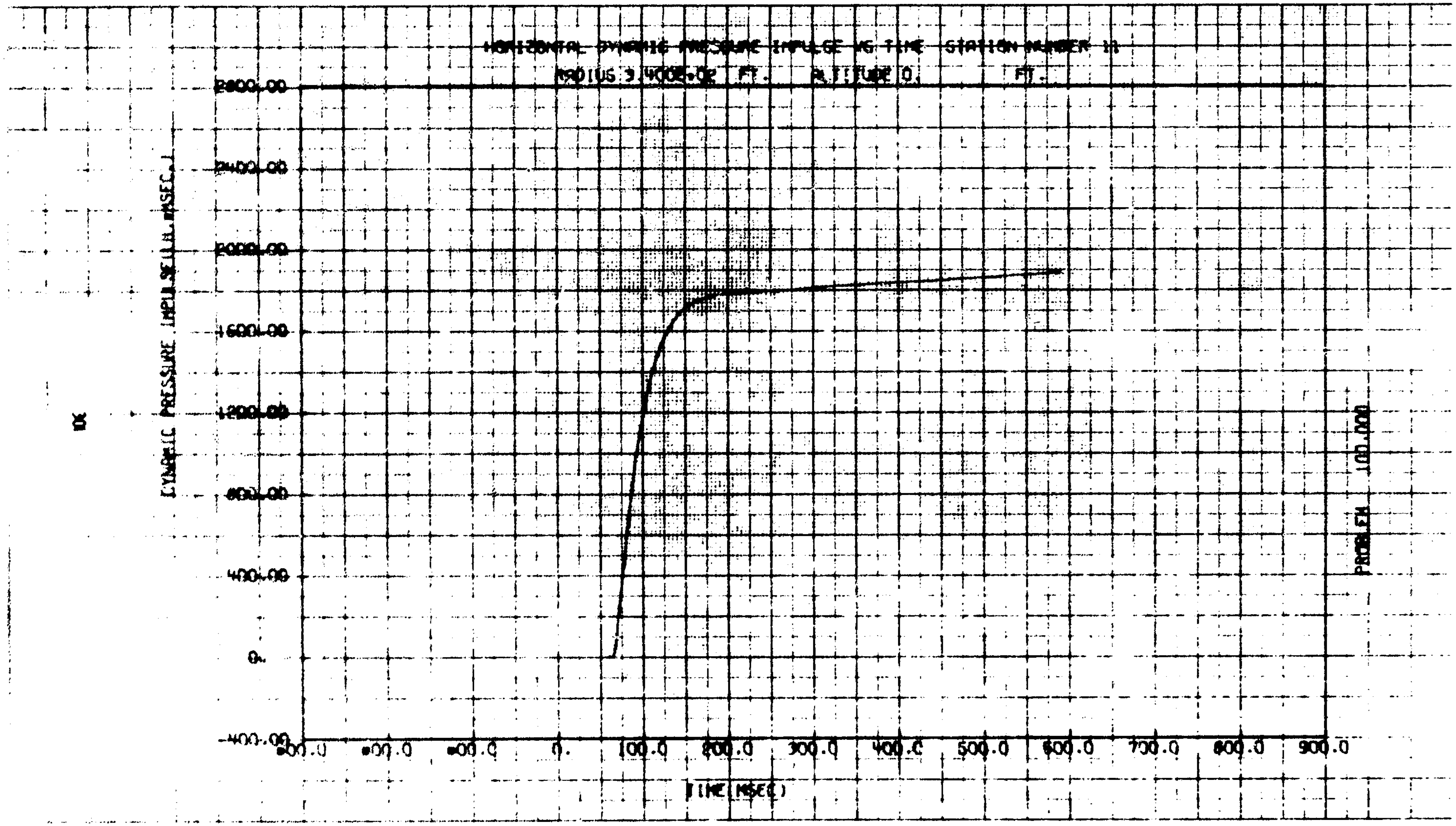
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2400.00
2000.00
1600.00
1200.00
800.00
400.00
0.
-400.00
-300.0
-200.0
-100.0
0.
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
TIME(MSEC)
PROBLEM 100.000

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

1 March 1967 to 1 April 1967

5. AUTHOR(S) (Last name, first name, initial)

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13. ABSTRACT

Theoretical calculations of the phenomenology of an atmospheric high-explosive detonation are presented. The charge was a 100-ton sphere (radius, 240.5 cm) of TNT (loading density, 1.56 gms/cm^3) whose center was at an altitude of 646.405 meters. The ground, upon which the spherical charge rested, was 644 meters above sea level. The numerical calculations taken out to 6 seconds were performed on the CDC 6600 digital computer using SHELL2, a two-material (version of the SHELL-OIL code), two-dimensional pure Eulerian hydrodynamic code. Air and the detonation products of TNT were the two materials considered in the calculation. The analytic, self-similar solution for the detonation wave in TNT provided the initial conditions. Included are pressure and density contours, velocity vector plots, and wave forms for 19 test stations. This calculation is a representation of the air blast of Event 6 of the DISTANT PLAIN test series to be fired in Canada, July 1967.

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14 KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
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